

02-117017-6

APOLLO PROGRAM

OFFICE OF MANNED
SPACE FLIGHT

FINAL FLIGHT EVALUATION REPORT APOLLO 9 MISSION

JUNE 1969

(NASA)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



70-34370

(ACCESSION NUMBER)

(THRU)

(PAGES)

(CODE)

(NASA CR OR TMX OR AD NUMBER)

(CATEGORY)

D2-117017-6
FLIGHT EVALUATION REPORT - APOLLO 9 MISSION

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ABSTRACT

THIS DOCUMENT IS THE FINAL FLIGHT EVALUATION REPORT FOR THE APOLLO 9 MISSION. IT INCLUDES DATA FROM THE NASA CENTER 5 DAY, 30 DAY AND 60 DAY REPORTS AS WELL AS THE ANOMALY STATUS REPORTS FROM MSC AND THE READINESS ASSESSMENT MATERIAL FOR THE APOLLO 10 MISSION. THE REPORT INCLUDES A SUMMARY OF THE MISSION, A SEQUENCE OF MISSION EVENTS, A LISTING OF MISSION OBJECTIVE ACCOMPLISHMENTS AND THE ANOMALIES ENCOUNTERED DURING THE MISSION. THE ANOMALIES ARE LISTED ACCORDING TO SPACECRAFT, LAUNCH VEHICLE AND GROUND SYSTEMS.

THIS DOCUMENT HAS BEEN PREPARED BY THE BOEING COMPANY WDC/TIE UNDER NASA/APO MAT-1 TECHNICAL DIRECTIVE CONTRACT NASW-1650, TASK NO. 10.0.

KEY WORDS

APOLLO 9

FLIGHT EVALUATION

OBJECTIVES

ANOMALIES

1.0 INTRODUCTION

APOLLO 9 (AS-504/CM-104/LM-3) WAS THE THIRD MANNED FLIGHT OF THE APOLLO SPACECRAFT, THE SECOND MANNED FLIGHT WITH THE SATURN V LAUNCH VEHICLE AND THE FIRST MANNED FLIGHT OF THE LUNAR MODULE. PREVIOUS FLIGHTS HAVE TESTED THE PERFORMANCE OF THE LAUNCH VEHICLE AND COMMAND AND SERVICE MODULE SPACECRAFT.

THIS FLIGHT, IN ADDITION TO DEMONSTRATING THE CREW/SPACE VEHICLE/MISSION SUPPORT FACILITIES' PERFORMANCE DURING A MANNED SATURN V MISSION, EVALUATED THE MANNED LUNAR MODULE AND DEMONSTRATED THE COMPATIBILITY OF THE CSM AND LM TO PERFORM COMBINED OPERATIONS TYPICAL OF A LUNAR MISSION.

1.1 CARRY-OVER ANOMALIES FOR SUBSEQUENT FLIGHT READINESS REVIEWS

APOLLO 9		REMARKS
2.1.3	HIGH. O ₂ FLOW RATE ON FUEL CELL #3.	SEE PAGE 29 FOR DISCUSSION.
2.1.4	FUEL CELL #2 CONDENSER EXIT TEMPERATURE HIGH.	SEE PAGE 31 FOR DISCUSSION.
2.1.25	ASCENT PROPULSION SYSTEM REGULATOR LEG BLOCKAGE.	SEE PAGE 66 FOR DISCUSSION.
2.2.1	S-II PROPULSION/STRUCTURAL OSCILLATIONS.	SEE PAGE 95 FOR DISCUSSION.

1.2 MISSION SUMMARY

APOLLO 9 WAS LAUNCHED FROM LAUNCH COMPLEX 39A AT CAPE KENNEDY ON MARCH 3, 1969 AT 11:00:00 HOURS, EST, AFTER BEING RESCHEDULED FROM A FEBRUARY 28 LAUNCH DATE DUE TO VIRUS RESPIRATORY INFECTIONS OF ALL CREW MEMBERS. THE CREW FOR THIS MISSION WERE J.A. MCDIVITT, COMMANDER, D.R. SCOTT, COMMAND MODULE PILOT, AND R.L. SCHWEICKART LUNAR MODULE PILOT. PRE-LAUNCH CONDITIONS WERE NOMINAL WITHOUT ANY UNSCHEDULED HOLDS. NO SIGNIFICANT PRE-LAUNCH PROBLEMS WERE ENCOUNTERED EXCEPT FOR AN S-IVB STAGE PNEUMATIC REGULATOR OUTLET OVERPRESSURE.

LAUNCH DAMAGE WAS LIGHT. ALL LAUNCH VEHICLE STAGES BURNED SLIGHTLY LONGER THAN PLANNED. LOW FREQUENCY PERFORMANCE OSCILLATIONS WERE EXPERIENCED BY THE APOLLO 9 CREW NEAR THE END OF THE S-II BURN. ORBITAL INSERTION OCCURRED AT 11 MINUTES 14.7 SECONDS GET. WITH AN ORBIT OF 103.3 X 102.3 NM WITH, A PERIOD OF 88.2 MINUTES, AN INCLINATION OF 32.5 DEGREES, AND AN INSERTION VELOCITY OF 25,567 FEET PER SECOND.

AFTER THE COMMAND MODULE SEPARATED FROM AND INSPECTED THE LM/S-IVB, TRANSPOSITION AND DOCKING PROCEEDED AS PLANNED AT 3 HOURS AND 2 MINUTES. FOLLOWING EXTRACTION OF THE LUNAR MODULE FROM THE S-IVB, THE CM/LM SPACECRAFT MOVED AWAY FROM THE S-IVB TO BE CLEAR DURING THE S-IVB RESTART. THE FIRST AND SECOND S-IVB RESTARTS OCCURRED AS PLANNED; HOWEVER, THE ENGINE CHAMBER DECREASED SLOWLY DURING THE THIRD S-IVB BURN (SECOND RESTART). HYPERBOLIC VELOCITY WAS OBTAINED AND THE S-IVB WAS INJECTED INTO A SOLAR ORBIT. THE PROPELLANT DUMP SCHEDULED TO FOLLOW THE THIRD BURN WAS NOT ACHIEVED.

JUST PRIOR TO THE SECOND S-IVB BURN, THE DOCKED SPACECRAFT MADE THE FIRST SERVICE PROPELLSION SYSTEM (SPS) BURN OVER HAWAII RAISING THE APOGEE TO 126 NM COMPLETING THE MAJOR ACTIVITIES SCHEDULED DURING THE FIRST DAY.

THE SECOND PERIOD ACTIVITIES CONSISTED OF THREE DOCKED SPS BURNS. THE FIRST TWO BURNS RAISED THE APOGEE TO 190 NM AND 272 NM, RESPECTIVELY. DURING THESE TWO BURNS, TESTS WERE MADE TO MEASURE THE OSCILLATORY RESPONSE OF A DOCKED SPACECRAFT TO PROVIDE DATA TO IMPROVE THE AUTOPILOT RESPONSE FROM THIS CONFIGURATION. THE LAST BURN LIGHTENED THE SPACECRAFT SO THAT IT COULD BE CONTROLLED BY THE RCS ENGINES LATER IN THE MISSION AND BE IN A BETTER RESCUE POSITION FOR RENDEZVOUS ACTIVITIES. THE FINAL SPS BURN WAS A PHASING BURN TO SHIFT THE NODE EAST AND PUT THE SPACECRAFT IN A BETTER POSITION LATER ON FOR LIGHTING, BRAKING, AND DOCKING.

THE THIRD PERIOD ACTIVITIES BEGAN BY PRESSURIZING THE LUNAR MODULE AND PREPARING FOR ACTIVITIES IN THE LUNAR MODULE. SOME DELAY WAS CAUSED WITH ALIGNING THE IMU BUT ENTRY INTO THE CM/LM

TUNNEL AND THE LM PROCEEDED WITHOUT FURTHER INCIDENT. LUNAR MODULE SYSTEMS EVALUATION PROCEEDED ON SCHEDULE FOLLOWING DELETION OF SEVERAL MINOR TESTS. DURING THIS PERIOD THE LM LANDING GEAR WAS EXTENDED SATISFACTORILY AND A LIVE TELEVISION TRANSMISSION WAS MADE FROM INSIDE THE LUNAR MODULE. THE PICTURE WAS GOOD, BUT THE SOUND WAS UNSATISFACTORY.

A SUCCESSFUL DOCKED LM DESCENT PROPULSION SYSTEM BURN WAS MADE. THIS BURN WAS MADE OUT OF PLANE WHICH DID NOT CHANGE THE ORBIT, BUT DID SHIFT THE NODE AS IN THE PREVIOUS DAYS ACTIVITIES. FOLLOWING THIS BURN THE LUNAR MODULE WAS POWERED DOWN AND THE ASTRONAUTS RETURNED TO THE COMMAND MODULE. DURING THE LATER PART OF THIS DAY THE SPS ENGINE WAS FIRED FOR THE FIFTH TIME CHANGING THE ORBIT TO 123 X 129 NM.

THE FOURTH PERIOD ACTIVITY BEGAN AS BEFORE WITH THE TWO CREW MEMBERS TRANSFERRING INTO THE LUNAR MODULE AND POWERING UP THE SYSTEMS. PREPARATIONS WERE MADE FOR THE EXTRAVEHICULAR ACTIVITIES (EVA) WHICH WERE MODIFIED FROM THE ORIGINAL PREPARATIONS. AFTER THE LUNAR MODULE PILOT (LMP) DONNED THE EXTRAVEHICULAR MOBILITY UNIT (EMU) AND THE NECESSARY CHECKS WERE COMPLETED, BOTH SPACECRAFT CABINS WERE DEPRESSURIZED.

ALTHOUGH THE EVA HAD BEEN MODIFIED BECAUSE OF THE LMP'S NAUSEA ON THE PREVIOUS DAY, THE COMMANDER (CDR) ASSESSED THE LMP'S CONDITION AT THIS TIME AS EXCELLENT AND, WITH GROUND CONTROL'S CONCURRENCE, DECIDED TO EXTEND THE EVA ACTIVITIES. THE LMP EGRESSED FROM THE LM AT 73 HRS, RETRIEVED THE THERMAL SAMPLES, AND EVALUATED THE EFFECTIVENESS OF THE LM EVA HANDRAILS, REPORTING HE COULD MANEUVER HIMSELF TO ANY POSITION AND REMAIN THERE WITH EASE. THE COMMAND MODULE PILOT (CMP) RETRIEVED ALL OF THE THERMAL SAMPLES FROM THE EXTERIOR OF THE CSM.

DURING THE EVA ALL SYSTEMS IN THE LM, CSM, AND EMU OPERATED SATISFACTORILY. THE TELEVISION TRANSMISSION DURING THE LATER PART OF THIS PERIOD WAS SUCCESSFULLY RECEIVED BY GROUND STATIONS. BOTH PICTURES AND VOICE QUALITY WERE EXCELLENT. FOLLOWING THE TV TRANSMISSION, THE CDR AND LMP COMPLETED POWER DOWN OF THE LM, RETURNED TO THE CM, AND SECURED THE TUNNEL HATCH.

FOLLOWING CM AND LM PREPARATION ACTIVITIES, THE MAJOR FIFTH PERIOD ACTIVITIES BEGAN WITH THE LM UNDOCKING FROM THE CSM. AFTER AN INSPECTION OF EACH VEHICLE, A SEPARATION MANEUVER WAS ACCOMPLISHED. A PHASING MANEUVER WAS THEN PERFORMED WITH THE DESCENT PROPULSION SYSTEM (DPS) TO RAISE THE LM ALTITUDE APPROXIMATELY 12 NM ABOVE THE CSM. THE FINAL DPS BURN INSERTED THE LM INTO A STABLE CONCENTRIC ORBIT 10 MILES HIGHER THAN THE CSM ORBIT. WHEN THE LM WAS ABOUT 75 NM FROM THE CSM, THE ASCENT AND DESCENT STAGES WERE SEPARATED.

A COELLIPTIC SEQUENCE INITIATION (CSI) MANEUVER WAS PERFORMED WITH THE REACTION CONTROL SYSTEM (RCS) LOWERING THE LM ORBIT TO APPROXIMATELY 10 MILES BELOW THE CSM ORBIT. A CONSTANT DELTA HEIGHT (CDH) MANEUVER WAS THEN MADE WITH THE APS ENGINE TO STABILIZE THE LM ORBIT APPROXIMATELY 10 NM BELOW AND 78 NM BEHIND THE CSM ORBIT.

THE TERMINAL PHASE WAS INITIATED WITH THE RCS ENGINES RAISING THE LM ASCENT STAGE TO THE CSM ALTITUDE. AFTER A PERIOD OF STATION-KEEPING TO PHOTOGRAPH BOTH VEHICLES, DOCKING WAS SUCCESSFULLY COMPLETED AT 99 HRS. SOME PROBLEMS WERE EXPERIENCED WITH THE CREWMAN OPTICAL ALIGNMENT SIGHT (COAS) DURING DOCKING.

THE APS BURN TO PROPELLANT DEPLETION WAS ACCOMPLISHED AS PLANNED WITH THE ASCENT STAGE ACHIEVING AN ORBIT 5747×124.5 NM. THE APS SHUTDOWN WAS CAUSED BY OXIDIZER DEPLETION AT THE PREDICTED TIME, WITH 29 PERCENT OF THE RCS PROPELLANT REMAINING.

THE SIXTH PERIOD INCLUDED THE LAST FIVE DAYS OF THE TEN DAY MISSION. DURING THIS PERIOD TWO ORBIT-SHAPING SPS BURNS AND THE FINAL SPS DEORBIT BURN WERE PERFORMED. THE ULLAGE BURN SCHEDULED PRIOR TO SPS BURN NO. 6 DID NOT OCCUR AT THE PROPER TIME AND THE CREW CANCELLED THE MANEUVER. IT WAS RESCHEDULED FOR THE NEXT REVOLUTION AND SUCCESSFULLY ACCOMPLISHED LOWERING THE PERIGEE TO 105 NM.

THE SEVENTH SPS BURN WAS LENGTHENED TO 25 SECONDS TO PERFORM A TEST ON THE PROPELLANT UTILIZATION GAGING SYSTEM (PUGS). THE BURN WAS RECONSTRUCTED AS A POSIGRADE, OUT-OF-PLANE, OFF-PERIGEE MANEUVER TO ACHIEVE THE ORIGINAL ORBIT. THE BURN PRODUCED THE DESIRED 250.2×97.8 NM ORBIT WITH PHENOMENAL ACCURACY.

EARTH RESOURCES AND MULTISPECTRAL PHOTOGRAPHY EXPERIMENTS (S065) WERE CONDUCTED DURING THIS PERIOD OVER THE SOUTHERN UNITED STATES, MEXICO, BRAZIL, AND AFRICA. AN INERTIAL MEASUREMENT UNIT (IMU) ALIGNMENT WAS MADE WITH A SIGHTING ON THE PLANET JUPITER. A NUMBER OF DAYLIGHT STAR SIGHTINGS, LANDMARK SIGHTINGS, AND STAR SEXTANT SIGHTINGS WERE MADE.

DURING TWO SUCCESSIVE REVOLUTIONS THE CREW SUCCESSFULLY TRACKED THE PEGASUS II SATELLITE USING THE CREWMAN OPTICAL ALIGNMENT SIGHT (COAS). A SIGHTING WAS ALSO MADE OF THE LM ASCENT STAGE.

DUE TO MARGINAL WIND AND SEA CONDITIONS IN THE PRIME RECOVERY AREA, THE DEORBIT MANEUVER WAS DELAYED ONE REVOLUTION TO A LOCATION 600 MILES EAST OF CUBA. THE BURN WAS CONDUCTED OVER HAWAII AT 240:31:14 GET WITH A PREDICTED TARGET POINT AT 23° 15'N. LATITUDE, 68° 00'W. LONGITUDE.

WEATHER IN THE RECOVERY AREA WAS EXCELLENT. DROGUE AND MAIN PARACHUTES WERE DEPLOYED. SPLASHDOWN WAS AT 241:00:52 GET, APPROXIMATELY 3 NM FROM THE PRIME RECOVERY SHIP GUADALCANAL AND 1.2 NM FROM THE TARGET. THE COMMAND MODULE REMAINED IN THE STABLE I POSITION AND THE CREW REPORTED THEY WERE IN GOOD SHAPE. THE CREW WAS PICKED UP BY A RECOVERY HELICOPTER AND WAS SAFE ABOARD THE SHIP AT 12:49:33 EST, MARCH 13, 1969.

1.3 APOLLO PROGRAM IMPACT

THE APOLLO 9 MISSION WAS THE THIRD MANNED APOLLO FLIGHT, THE SECOND USING THE SATURN V BOOSTER. THIS MISSION FURTHER DEMONSTRATED THE SATISFACTORY PERFORMANCE OF THE SPACE VEHICLE AS WELL AS THE CREW, TELECOMMUNICATIONS, AND THE MISSION SUPPORT FACILITIES IN EARTH ORBIT. IN ADDITION, THIS MISSION SUCCESSFULLY DEMONSTRATED OPERATION OF THE LUNAR MODULE IN EARTH ORBIT.

THE APOLLO 9 MISSION WAS COMPLETED WHEN THE COMMAND MODULE WAS RECOVERED FROM THE ATLANTIC RECOVERY AREA ON MARCH 13, 1969. SUFFICIENT DATA WAS OBTAINED TO VERIFY THAT ALL PRIMARY OBJECTIVES WERE MET. NO MAJOR ANOMALIES WERE ENCOUNTERED WHICH WOULD IMPOSE A CONSTRAINT ON FUTURE MISSIONS WITH THIS VEHICLE.

THE SUCCESS OF THIS MISSION VERIFIED THE PERFORMANCE OF THE SPACE VEHICLE AND SUPPORT SYSTEMS ENABLING THE PROGRAM TO PROCEED WITH LUNAR MISSIONS.

1.4 SUMMARY OF MISSION ACCOMPLISHMENTS

PRIMARY MISSION OBJECTIVES

- o DEMONSTRATE CREW/SPACE VEHICLE/MISSION SUPPORT FACILITIES PERFORMANCE DURING A MANNED SATURN V MISSION WITH CSM AND LM.
- o DEMONSTRATE LM/CREW PERFORMANCE.
- o DEMONSTRATE PERFORMANCE OF NOMINAL AND SELECTED BACKUP LUNAR ORBIT RENDEZVOUS (LOR) MISSION ACTIVITIES, INCLUDING:
 - TRANSPOSITION, DOCKING, LM WITHDRAWAL
 - INTERVEHICULAR CREW TRANSFER
 - EXTRAVEHICULAR CAPABILITY
 - SPS AND DPS BURNS
 - LM ACTIVE RENDEZVOUS AND DOCKING
- o CSM/LM CONSUMABLES ASSESSMENT

ALL OF THE APOLLO 9 PRIMARY MISSION OBJECTIVES WERE OBTAINED. TWO OF THE SPACECRAFT DETAILED OBJECTIVES WERE ONLY PARTIALLY COMPLETED. THE DETAILED TEST OBJECTIVES AS DEFINED IN THE MISSION IMPLEMENTATION PLAN AND MISSION REQUIREMENTS DOCUMENT, AMPLIFY BUT DO NOT MODIFY THE PRIMARY MISSION OBJECTIVES.

TABLE I IS A LISTING OF EVENT TIMES COMPARING THE DIFFERENCE BETWEEN PRE-MISSION PLANNED EVENT TIMES AND ACTUAL MISSION TIMES. A LISTING OF LAUNCH VEHICLE AND SPACECRAFT DETAILED TEST OBJECTIVES, ALONG WITH THE RESPECTIVE DEGREE OF ACCOMPLISHMENT IS SHOWN ON THE FOLLOWING PAGES.

OBJECTIVE

ACCOMPLISHMENT

LAUNCH VEHICLE

1. (P) DEMONSTRATE S-IVB/IU ATTITUDE CONTROL CAPABILITY DURING TRANSPOSITION, DOCKING AND LM EJECTION (TD&E) MANEUVER.
2. (S) DEMONSTRATE S-IVB RESTART CAPABILITY.
3. (S) VERIFY J-2 ENGINE MODIFICATIONS.
4. (S) CONFIRM J-2 ENVIRONMENT IN S-II STAGE.
5. (S) CONFIRM LAUNCH VEHICLE LONGITUDINAL OSCILLATION ENVIRONMENT DURING S-IC STAGE BURN PERIOD.
6. (S) DEMONSTRATE O₂H₂ BURNER REPRESSURIZATION SYSTEM OPERATION.
7. (S) DEMONSTRATE S-IVB PROPELLANT DUMP AND SAFING.
8. (S) VERIFY THAT MODIFICATIONS INCORPORATED IN THE S-IC STAGE SUPPRESS LOW FREQUENCY LONGITUDINAL OSCILLATIONS.
9. (S) DEMONSTRATE 80 MINUTE RESTART CAPABILITY.
10. (S) DEMONSTRATE DUAL REPRESSURIZATION CAPABILITY.
11. (S) DEMONSTRATE O₂H₂ BURNER RESTART CAPABILITY.

ATTITUDE WAS MAINTAINED DURING THIS MANEUVER.

THE S-IVB WAS SUCCESSFULLY RESTARTED.

J-2 ENGINE MODIFICATIONS WERE SUCCESSFUL.

ENVIRONMENTAL DATA WERE OBTAINED.

ENVIRONMENTAL DATA WERE OBTAINED.

THE SYSTEM OPERATED SATISFACTORILY.

DATA DOES NOT CONFIRM A PROPELLANT DUMP.

NO "POGO" PHENOMENA WERE MEASURED DURING THE S-IC BURN.

THE S-IVB WAS SUCCESSFULLY RESTARTED AFTER 80 MINUTES.

THIS OBJECTIVE WAS SUCCESSFULLY DEMONSTRATED.

O₂H₂ BURNER RESTART CAPABILITY WAS SUCCESSFULLY DEMONSTRATED.

OBJECTIVE

ACCOMPLISHMENT

12. (S)

VERIFY THE ONBOARD COMMAND AND COMMUNICATIONS SYSTEM (CCS)/GROUND SYSTEM INTERFACE AND OPERATION IN THE DEEP SPACE ENVIRONMENT.

THE CCS SYSTEM WAS SUCCESSFULLY DEMONSTRATED.

SPACE VEHICLE

M13.12

DPS BURN DURATION EFFECTS AND PRIMARY PROPULSION/VEHICLE INTERACTIONS.

DATA WAS COLLECTED DURING THE DOCKED DPS BURN AND THE RENDEZVOUS.

-PERFORM A LONG DURATION DPS BURN AND OBTAIN DATA ON SLOSH, VIBRATIONS, AND PERFORMANCE INTERACTIONS.

M17.17

LM ENVIRONMENTAL AND PROPULSION THERMAL EFFECTS.

LM ENVIRONMENTAL AND THERMAL EFFECT DATA WERE COLLECTED DURING THE DOCKED DPS BURN, EVA, AND THE POST-RENDEZVOUS INSPECTION.

-VERIFY PERFORMANCE OF PASSIVE THERMAL SUBSYSTEMS

M17.18

LM STRUCTURE INTEGRITY

THE LM STRUCTURE WITHSTOOD ALL FLIGHT LOADS.

-DEMONSTRATE STRUCTURAL INTEGRITY OF THE LM DURING FLIGHT.

M11.6

LM PGNCs/DAP PERFORMANCE AND THRUST PERFORMANCE.

THE PRIMARY GUIDANCE NAVIGATION AND CONTROL SYSTEM/DIGITAL AUTO-PITCH PERFORMANCE WAS MONITORED AND FOUND ACCEPTABLE DURING DPS BURNS #1 AND 2.

-PERFORM A MANUAL THROTTLE SHORT DURATION DOCKED DPS BURN AND A MEDIUM DURATION UNDOCKED BURN.

<u>OBJECTIVE</u>	<u>ACCOMPLISHMENT</u>
<p>M13.11 LONG DURATION APS BURN</p> <p>-PERFORM A LONG DURATION APS BURN.</p>	<p>A BURN TO DEPLETION WAS PERFORMED BY THE APS FOR AN EXTENDED PERIOD.</p>
<p>M14 LM/ECS PERFORMANCE</p> <p>-DEMONSTRATE THE ECS DURING LM ACTIVITIES.</p>	<p>THE ECS PERFORMED SATISFACTORILY ALTHOUGH MINOR PROBLEMS OCCURRED IN THE SYSTEM.</p>
<p>M17.9 LANDING GEAR DEPLOYMENT/THERMAL EFFECTS.</p> <p>-DEPLOY LM LANDING GEAR AND OBTAIN DATA ON GEAR TEMPERATURES DURING A DPS BURN.</p>	<p>GEAR WAS SUCCESSFULLY DEPLOYED AND TEMPERATURE DATA WAS RECORDED DURING DPS BURNS.</p>
<p>M15.3 LM/EPS PERFORMANCE DETERMINATION</p> <p>-DETERMINE THE PERFORMANCE OF THE LM ELECTRICAL POWER SUBSYSTEM IN THE PRIMARY AND BACKUP MODES.</p>	<p>THE ELECTRICAL POWER SUBSYSTEM SUFFICED FOR THE MISSION ALTHOUGH SOME PROBLEMS OCCURRED IN THE FUEL CELLS.</p>
<p>M16.7 LANDING RADAR/STRUCTURE/PLUME.</p> <p>-OPERATE THE LANDING RADAR DURING DPS BURNS.</p>	<p>THE LANDING RADAR FUNCTIONED PROPERLY DURING THE DPS BURNS. PHOTOGRAPHY AND TRANSDUCER DATA WAS RECORDED.</p>
<p>P12.4 AGS ΔV CAPABILITY USING DPS</p> <p>-PERFORM AGS/CES CONTROLLED DPS BURN WITH A HEAVY DESCENT STAGE.</p>	<p>THE VEHICLE SUCCESSFULLY COMPLETED AND RECORDED THE ΔV RESPONSE DURING THE DPS BURN.</p>

OBJECTIVE

ACCOMPLISHMENT

P11.14	PGNCS CONTROLLED APS BURN -PERFORM A PGNCS/DAP CONTROLLED LONG DURATION APS BURN.	A MONITORED APS DEPLETION BURN WAS PERFORMED AND THE PGNCS/DAP FUNCTIONED PROPERLY.
P11.7	PGNCS ATTITUDE/TRANSLATION CONTROL -DEMONSTRATE STAGED LM-RCS TRANSLA- TION AND ATTITUDE CONTROL USING AUTO AND MANUAL PGNCS CONTROLS.	LM ATTITUDE CONTROL WAS MAINTAINED DURING ALL PGNCS MANEUVERS.
P20.22	LM/CSM/MSFN S-BAND/VHF COMPATIBILITY. -DEMONSTRATE LM/CSM/MSFN/EVA OPERA- TIONAL S-BAND & VHF COMMUNICATION COMPATIBILITY.	THE COMPATIBILITY WAS ACCEPTABLE BUT SPORATIC FAILURES WERE ENCOUNTERED.
P12.3	AGS/CONTROL ELECTRIC SECTION ATTITUDE/ TRANSLATION CONTROL -DEMONSTRATE RCS TRANSLATION AND ATTITUDE CONTROL OF UNSTAGED LM USING AUTO AND MANUAL AGS/CONTROL ELECTRIC SECTION CONTROL MODES.	THE AGS/CONTROL ELECTRIC SECTION CON- TROL WAS SATISFACTORILY DEMONSTRATED.
P1.23	CSM AUTO PILOT STABILITY MARGIN -DEMONSTRATE ATTITUDE CONTROL DUR- ING SPS DOCKED BURNS	THE CSM ATTITUDE CONTROL DURING THE SPS BURNS (1, 2 AND 3) WAS SATISFAC- TORY.
P20.28	LM ACTIVE DOCKING -DEMONSTRATE LM ACTIVE DOCKING CAPABILITY WITH THE PASSIVE CSM.	THE LM ASCENT STAGE PERFORMED A suc- cessful docking with the CSM.

OBJECTIVE

ACCOMPLISHMENT

P20.25	LM EJECTION FROM SLA -DEMONSTRATE LM SEPARATION & EJECTION OF THE CSM/LM FROM THE SLA.	A SUCCESSFUL EJECTION OF THE CSM/LM FROM THE SLA WAS OBTAINED.
P20.24	CSM ACTIVE DOCKING -DEMONSTRATE CSM DOCKING WITH THE S-IVB/SLA/LM.	A SUCCESSFUL DOCKING WAS PERFORMED BY THE CSM AND THE LAUNCH VEHICLE/ LUNAR MODULE COMBINATION.
P20.26	LM-CSM UNDOCKING -DEMONSTRATE THE UNDOCKING TECHNIQUE OF THE LM FROM THE CSM FOR LUNAR DESCENT.	THE UNDOCKING MANEUVER WAS PERFORMED SATISFACTORILY.
P11.10	PGNCS AND GNCS IMU PERFORMANCE -OBTAIN DATA TO VERIFY IMU PERFORMANCE IN THE FLIGHT ENVIRONMENT.	LM PRIMARY GUIDANCE NAVIGATION CONTROL SYSTEM AND CSM GUIDANCE NAVIGATION CON- TROL SYSTEM IMU PERFORMANCE DATA WERE COLLECTED THROUGHOUT THE MISSION.
P2.9	GNCS/MTVC TAKEOVER -PERFORM MANUAL THRUST VEC- TOR CONTROL TAKEOVER OF A GNCS INITIATED SPS DOCKED BURN.	MANUAL THRUST VECTOR CONTROL (MTVC) TAKEOVER DATA WAS OBTAINED DURING SPS BURN 3.

OBJECTIVE

P16.4

RENDEZVOUS RADAR TRACKING
PERFORMANCE

-DEMONSTRATE TRACKING ABILITY
OF CSM RENDEZVOUS RADAR TRANS-
PONDER AT VARIOUS RANGES BE-
TWEEN THE CSM AND LM.

P20.21

LM/MSFN S-BAND COMMUNICATION
PERFORMANCE

-DEMONSTRATE THE CAPABILITY
OF THE OPERATIONAL S-BAND
COMMUNICATION SUBSYSTEM

P20.34

INTRAVEHICULAR CREW TRANSFER

-DEMONSTRATE CREW CAPABILITY
TO TRANSFER THEMSELVES AND EQUIP-
MENT FROM THE CM TO THE LM AND
RETURN.

P12.2

AGS INFLIGHT CALIBRATION AND PER-
FORMANCE

-DEMONSTRATE AN AGS CALIBRATION
AND OBTAIN AGS PERFORMANCE DATA.

P11.5

LM/IMU INFLIGHT ALIGNMENT

-PERFORM LM IMU ALIGNMENTS USING
THE AOT AND CALIBRATE THE COAS.

ACCOMPLISHMENT

THE LM RENDEZVOUS TRACKING
RADAR PERFORMED SATISFACTORILY.

THIS COMMUNICATION SUBSYSTEM FUNC-
TIONED SATISFACTORILY ALTHOUGH
INTERMITTANT DISCREPANCIES OCCURRED.

THE CREW WAS SUCCESSFUL IN MAKING
THE TRANSFER IN THE TIME ALLOTTED.

ABORT GUIDANCE SYSTEM (AGS) CALIBRA-
TION AND PERFORMANCE DATA WAS COL-
LECTED DURING THE DOCKED DPS BURN
AND THE RENDEZVOUS PHASING BURN.

LM INFLIGHT IMU ALIGNMENT DATA WAS
COLLECTED AT VARIOUS TIMES DURING LM
ACTIVITY PERIODS.

OBJECTIVE

ACCOMPLISHMENT

P20.29	LM JETTISON -PERFORM A PYROTECHNIC SEPARATION OF THE LM AND CSM.	A SEPARATION OF THE LM FROM THE CSM WAS COMPLETED AS SCHEDULED.
P16.19	RENDEZVOUS RADAR/RCS IMPINGEMENT/CORONA EFFECT -OBTAIN DATA ON RENDEZVOUS RADAR CORONA SUSCEPTIBILITY DURING DOCKED LM -X TRANSLATION RCS, ENGINE BURNS.	DATA WERE OBTAINED. THE RENDEZVOUS RADAR (RR) FAILED TO UNLOCK.
P20.31	SUPPORT FACILITIES PERFORMANCE -DEMONSTRATE MISSION SUPPORT FACILITIES PERFORMANCE DURING AN EARTH ORBITAL MISSION.	COMPLETE FACILITIES SUPPORT WAS PROVIDED BY MSFN DURING THE MISSION.
P1.25	IMU ORIENTATION DETERMINATION/VISIBILITY -PERFORM A STAR PATTERN VISIBILITY CHECK IN DAYLIGHT WHILE DOCKED.	MANY DAYTIME SIGHTINGS WERE MADE WITH VISIBLE STAR PATTERNS ALTHOUGH REFLECTIVE LIGHT HINDERED THE TESTS AT INTERVALS.
P1.24	CSM/IMU ALIGNMENT ACCURACY -PERFORM IMU ALIGNMENTS USING THE SXT WHILE DOCKED.	MANY IMU ALIGNMENTS WERE PERFORMED DURING THE MISSION.

OBJECTIVE

ACCOMPLISHMENT

P20.33	CSM SINGLE CREWMAN RENDEZVOUS CAPABILITY -PERFORM PROCEDURES REQUIRED TO PREPARE FOR A CSM ACTIVE RENDEZVOUS WITH THE LM.	THE CSM WAS MAINTAINED IN A RECOVERY MODE DURING THE LM SIMULATED DESCENT.
P16.6	LANDING RADAR SELF-TEST -PERFORM A LANDING RADAR SELF-TEST	THE LANDING RADAR RESPONDED PROPERLY TO THE SELF-TEST OPERATION.
S7.29	EXHAUST EFFECTS/CSM -OBTAIN DATA ON EXHAUST EFFECTS UPON CSM BY TOWER MOTOR, S-II RETRO-ROCKETS AND SM RCS.	SPACECRAFT EXHAUST EFFECTS DATA WERE COLLECTED FOLLOWING EARTH ORBITAL INSERTION, LM/CSM EJECTION, DURING THE REVISED EVA PERIOD AND DURING THE POST-RENDEZVOUS INSPECTION (NOTE: THE REVISED EVA PERMITTED RECOVERY OF ONLY PART OF THE THERMAL SAMPLES).
S20.32	CREW ACTIVITIES EVALUATION CSM/LM -EVALUATE ONE-MAN LM OPERATION CAPABILITY, AND OBTAIN DATA ON CREW MANEUVERABILITY, CREW COMPARTMENTATION, AND PROPULSIVE	THE CREW WAS SUCCESSFUL IN PERFORMING THEIR LM MISSION AND TASKS.
S1.26	ORBITAL NAVIGATION/LANDMARK TRACKING -PERFORM UNDOCKED LANDMARK TRACKING USING THE YAW/ROLL TECHNIQUE.	ORBITAL NAVIGATION/LANDMARK TRACKING DATA WERE OBTAINED AT VARIOUS TIMES DURING THE MISSION AND SPECIFICALLY DURING SUBSEQUENT TRACKING ACTIVITIES.

OBJECTIVE

ACCOMPLISHMENT

S13.10	APS BURN TO DEPLETION -TO PERFORM AN APS DEPLETION BURN.	A SUCCESSFUL APS DEPLETION BURN WAS PERFORMED.
S20.37	DPS PLUME EFFECTS -OBTAIN DATA ON THE DPS PLUME EFFECTS ON ASTRONAUT'S VISI- BILITY.	THE DPS DID NOT AFFECT THE CREW'S VISIBILITY DURING ITS TWO BURNS.
S20.120	CSM/LM ELECTROMAGNETIC COMPATI- BILITY. -OBTAIN DATA ON THE ELECTRO- MAGNETIC COMPATIBILITY OF THE CSM, LM, AND PLSS.	IT APPEARS THAT THE CSM, LM, AND PLSS ARE ELECTROMAGNETICALLY COMPATIBLE WITH REGARDS TO ANY CONDUCTED OR RADIATED EMI.
P20.27	LM EVALUATION RENDEZVOUS -PERFORM AN LM ACTIVE RENDEZ- VOUS WITH A PASSIVE CSM.	THE LM SYSTEMS, PARTICULARLY THE PGNS AND AGS, PERFORMED ACCURATELY DURING THE CSM.
P20.35	EXTRAVEHICULAR ACTIVITY -DEMONSTRATE EXTRAVEHICULAR TRANSFER AND OBTAIN EXTRAVEHICULAR ACTIVITY DATA.	A MODIFIED EVA PROGRAM WAS PERFORMED WHICH FULFILLED THE MAJOR REQUIREMENTS OF THE ORIGINAL PROGRAMS.
(M)	INDICATES A MANDATORY OBJECTIVE	
(P)	INDICATES A PRINCIPAL OBJECTIVE	
(S)	INDICATES A SECONDARY OBJECTIVE	

TABLE 1 APOLLO 9 SEQUENCE OF EVENTS

PRE-LAUNCH PHASE

SPACE VEHICLE AND LAUNCH VEHICLE CHECKOUT PROCEEDED AS PLANNED TO T-16 HOURS ON 2-27-69. DURING THE SCHEDULED 3-HOUR HOLD AT THIS TIME, THE SPACE VEHICLE WAS RESCHEDULED TO T-42 HOURS BECAUSE OF THE ASTRONAUTS MEDICAL CONDITION. THE COUNT WAS RESUMED ON 3-1-69 AND PROCEEDED TO AN ON TIME LAUNCH WITHOUT ANY UNSCHEDULED HOLDS.

LAUNCH PHASE

EVENT	PLANNED HR:MIN:SEC	ACTUAL HR:MIN:SEC	DIFFERENCE	
			+	-
RANGE ZERO (11:00:00.0 EST)	00:00:00.0	00:00:00.0		
LIFTOFF (IU UMBILICAL DISCONNECT - TB1)	00:00:00.7	00:00:00.7		
PITCH AND ROLL INITIATE	00:00:11.5	00:00:13.3	+	:01.8
ROLL COMPLETE	00:00:30.3	00:00:33.0	+	:02.7
MAXIMUM DYNAMIC PRESSURE	00:01:21.4	00:01:25.5	+	:04.1
CENTER ENGINE CUTOFF (TB2)	00:02:14.3	00:02:14.3		
PITCH COMPLETE	00:02:37.0	00:02:38.0	+	:01.0
OUTBOARD ENGINE CUTOFF (TB3)	00:02:40.0	00:02:42.8	+	:02.8
S-IC/S-II SEPARATION	00:02:40.7	00:02:43.5	+	:02.7
S-II IGNITION	00:02:42.4	00:02:44.2	+	:01.8
S-II SECOND PLANE SEPARATION	00:03:10.7	00:03:13.5	+	:02.8

LAUNCH PHASE (CONTINUED)

EVENT	PLANNED	ACTUAL	DIFFERENCE
	HR:MIN:SEC	HR:MIN:SEC	
LET JETTISON	00:03:16.2	00:03:18.3	+ :02.1
S-II ENGINES CUTOFF (TB4)	00:08:51.2	00:08:56.2	+ :05.0
S-II/S-IVB SEPARATION	00:08:52.0	00:08:57.2	+ :05.2
S-IVB IGNITION	00:08:55.2	00:09:00.8	+ :05.6
S-IVB CUTOFF (TB5)	00:10:48.7	00:11:04.7	+ :16.0

ORBITAL PHASE

ORBITAL INSERTION	00:10:58.7	00:11:14.7	+ :16.0
CSM/S-IVB SEPARATION	02:43:00.0	02:41:16.0	+ 2:00.0
CSM/LM DOCKING	03:05:00.0	03:01:59.0	+ 3:01.0
CSM-LM/S-IVB EJECTION	04:08:57.0	04:08:05.0	- :51.0
SECOND S-IVB IGNITION	04:45:49.8	04:45:55.5	+ :05.7
SECOND S-IVB CUTOFF	04:46:52.4	04:46:57.6	+ :05.2
SPS BURN #1	06:01:40.0	05:59:01.1	- 2:38.9
THIRD S-IVB IGNITION	06:07:12.8	06:07:19.3	+ :06.5
THIRD S-IVB CUTOFF	06:11:14.0	06:11:21.3	+ :07.3

ORBITAL PHASE (CONTINUED)

EVENT	PLANNED HR:MIN:SEC	ACTUAL HR:MIN:SEC	DIFFERENCE	
			+ -	HR:MIN:SEC
SPS BURN #2	22:12:00.0	22:12:04.1	+	:04.1
SPS BURN #3	25:18:30.0	25:17:39.3	-	:50.7
SPS BURN #4	28:28:00.0	28:24:41.4	-	3:18.6
DPS DOCKED BURN	49:42:00.0	49:41:34.5	-	:25.5
SPS BURN #5	54:25:19.0	54:26:12.3	+	:53.3
CSM-LM UNDOCKING	92:39:00.0	92:39:36.0	+	:36.0
LM PHASING BURN	93:51:34.0	93:47:35.4	-	3:58.6
LM RENDEZVOUS INSERTION BURN	95:43:22.0	95:39:08.1	-	4:13.9
LM DESCENT-ASCENT STAGING	96:22:00.0	96:16:06.5	-	5:53.5
LM RCS COELLIPTIC SEQ. INIT. (CSI) BURN				
LM CONST. DELTA HEIGHT (CDH) BURN	97:05:27.0	96:58:15.0	-	7:07 0
LM TERMINAL PHASE INITIATION (TPI) BURN	98:00:10.0	97:57:59.0	-	2:11.0
LM-CSM RENDEZVOUS DOCKING "LOCK-UP"	99:13:00.0	99:02:26.0	-	10:30.0
LM JETTISON	101:53:00.0	101:22:45.0	-	30:15.0

ORBITAL PHASE (CONTINUED)

EVENT	PLANNED	ACTUAL	DIFFERENCE
	HR:MIN:SEC	HR:MIN:SEC	
LM ASCENT DEPLETION BURN	101:58:00.0	101:53:15.4	- 4:44.6
SPS BURN #6 (ORIGINAL ABORTED)	121:58:48.0		
SPS BURN #6 (RESCHEDULED)	123:25:06.0	123:25:07.0	+ :01.0
SPS BURN #7	169:47:54.0	169:39:00.0	- 8:54.0

EARTH ENTRY PHASE

RETRO-FIRE (SPS BURN #8 - DELAYED)	238:45:00.0		
RETRO-FIRE (RESCHEDULED NEXT ORBIT)	240:31:14.0	240:31:14.9	+ 00.9
400 K ALT.	240:44:22.0	240:44:10.2	- 11.8
BEGIN BLACKOUT	240:47:21.0	240:47:01.0	- 20.0
END BLACKOUT	240:50:45.0	240:50:43.0	- 2.0
DROGUE CHUTE DEPLOYMENT	240:55:05.0	240:55:07.8	+ 2.8
MAIN CHUTE DEPLOYMENT	240:55:53.0	240:55:59.0	+ 6.0
SPLASHDOWN	241:00:48.0	241:00:54.0	+ 6.0

2.0 ANOMALY LISTING

THIS SECTION CONTAINS A LISTING OF ANOMALIES OR PROBLEMS RESULTING FROM THE MISSION. THEY ARE LISTED ACCORDING TO SPACECRAFT (COMMAND SERVICE MODULE AND LUNAR MODULE), LAUNCH VEHICLE AND GROUND SYSTEMS. THE TERM ANOMALY IS USED FOR CONVENIENCE THROUGHOUT THIS REPORT TO REFER TO UNPLANNED GROUND AND FLIGHT EVENTS OR PROBLEMS. THE THIRTY-DAY REPORTS FROM THE NASA CENTERS CREATE THE OFFICIAL LIST OF SIGNIFICANT ANOMALIES.

SPACECRAFT (MSC) - COMMAND MODULE

- 2.1.1 PROPELLANT ISOLATION VALVE CLOSURE.
- 2.1.2 INDICATED SERVICE PROPULSION PROPELLANT UNBALANCE.
- 2.1.3 HIGH O₂ FLOW RATE ON FUEL CELL NO. 3
- 2.1.4 FUEL CELL NO. 2 CONDENSER EXIT TEMPERATURE HIGH.
- 2.1.5 LOSS OF AUTOMATIC CRYOGENIC HYDROGEN PRESSURE CONTROL.
- 2.1.6 NO VOICE UPLINK COMMUNICATIONS WITH S/C DURING EVA.
- 2.1.7 UPLINK COMMANDS NOT ACCEPTED.
- 2.1.8 MASTER ALARM AT DOCKING.
- 2.1.9 SPACECRAFT DISPLAY SPS HELIUM PRESSURE WENT TO ZERO DURING LIFTOFF.
- 2.1.10 ERROR IN COMMAND MODULE COMPUTER ORBIT CALCULATIONS.
- 2.1.11 SCANNING TELESCOPE SHAFT DRIVE PROBLEM.
- 2.1.12 ERRONEOUS DOCKING PROBE INDICATIONS.
- 2.1.13 NO. 1 CABIN FAN OVERHEATED.
- 2.1.14 CREW EXERCISER FAILED.
- 2.1.15 PARTIAL LOSS OF BIO-MED DATA.
- 2.1.16 ENTRY MONITOR SYSTEM (EMS) FAILURE.
- 2.1.17 CENTRAL TIMING RESET TO ZERO.
- 2.1.18 BATTERY "B" LOW CAPACITY.
- 2.1.19 COMPUTER RESPONSE TO DSKY ENTRIES
- 2.1.20 DAMAGE TO MAIN PARACHUTES
- 2.1.21 DOCKING RING SEPARATION CHARGE HOLDER.

LUNAR MODULE

- 2.1.22 DPS HELIUM REGULATOR MANIFOLD PRESSURE DROP.
- 2.1.23 SUPERCRITICAL HELIUM PRESSURE DECAY.
- 2.1.24 RCS THRUST CHAMBER PRESSURE SWITCH FAILED.
- 2.1.25 ASCENT PROPULSION SYSTEM REGULATOR FAILURE LEG BLOCKAGE.
- 2.1.26 ROUGH DESCENT ENGINE THROTTLING.

- 2.1.27 OSCILLATIONS IN PITCH DURING APS BURN.
- 2.1.28 NO ONBOARD INDICATION OF LM DPS SUPERCRITICAL HELIUM PRESSURES.
- 2.1.29 OXYGEN PURGE SYSTEM LIGHT.
- 2.1.30 DESCENT FUEL TANK TEMPERATURE SHIFTS.
- 2.1.31 LM VALVE POSITION INDICATOR ON LMP SUIT CONNECT/DISCONNECT IS INOPERATIVE.
- 2.1.32 ABORT GUIDANCE SYSTEM (AGS) CAUTION AND WARNING LIGHT ON.
- 2.1.33 PUSH-TO-TALK SWITCHES INOPERATIVE.
- 2.1.34 TRACKING LIGHT FAILURE.
- 2.1.35 LIGHTING FOR CREW OPTICAL ALIGNMENT SIGHT.
- 2.1.36 LOOSE PARTICLES DURING DPS BURN.
- 2.1.37 DISCREPANT ASCENT TANK WATER QUANTITY INDICATION.
- 2.1.38 STRUCTURAL CONTACT AT S-IC SHUTDOWN
- 2.1.39 BINDING OF FORWARD HATCH AND FAILURE OF DOOR STOP.
- 2.1.40 DATA ENTRY AND DISPLAY ASSEMBLY OPERATOR ERROR LIGHT.

LAUNCH VEHICLE (MSFC)

- 2.2.1 S-II PROPULSION/STRUCTURAL OSCILLATIONS.
- 2.2.2 S-IVB APS MODULE II HELIUM SUPPLY PRESSURE DECAY.
- 2.2.3 S-IVB STAGE PNEUMATIC REGULATOR READING HIGH.
- 2.2.4 S-IVB THIRD BURN PERFORMANCE VARIATIONS.

GROUND SYSTEMS (KSC)

THERE WERE NO SIGNIFICANT GROUND SYSTEM ANOMALIES. SOME MINOR DISCREPANCIES ARE LISTED IN SECTION 2.3.0.

ANOMALY REPORT

<p>NO. 2.1.1.1</p> <p>SYSTEM: SM</p> <p>SUBSYSTEM: RCS</p>	<p>TITLE: PROPELLANT ISOLATION VALVE CLOSURES</p> <p>MISSION: APOLLO 9</p> <p>EVENT TIME: 03:00</p> <p>PROBLEM: PRIOR TO CSM-LM DOCKING, NO LEFT (-Y) TRANSLATION COULD BE OBTAINED. THE CREW REPORTED THAT ALL NORMALLY OPEN PROPELLANT ISOLATION VALVES ON QUAD C AND THE SECONDARY VALVES FOR QUAD D OF THE SM REACTION CONTROL SYSTEM WERE CLOSED. THE VALVES WERE OPENED BY THE CREW AND ALL THRUSTERS PERFORMED SATISFACTORILY.</p> <p>THE ISOLATION VALVES WERE VERIFIED OPEN DURING COUNTDOWN, AND THE TIME THEY WERE CLOSED HAS NOT BEEN DETERMINED. FIVE POSSIBLE EXPLANATIONS FOR CLOSURE:</p> <div data-bbox="734 883 837 2033"> <ul style="list-style-type: none"> A) VIBRATION AND SHOCK B) ELECTRICAL TRANSIENT C) CREW BUMPED SWITCHES D) SWITCH CONTAMINATION E) REDUCED LATCHING FORCES </div> <p>ACTION: THE PROPELLANT ISOLATION VALVES IN THE COMMAND MODULE REACTION CONTROL SYSTEM ARE IDENTICAL TO THOSE IN THE SERVICE MODULE SYSTEM. TO DETERMINE WHETHER THE MAGNETIC LATCHING FORCE OF THE VALVES COULD HAVE BEEN DETERIORATED, THE VALVES ON COMMAND MODULE 103 AND 104 WERE CHECKED. THE DATA FROM THESE TESTS SHOWED NOMINAL FORCES, COMPARING FAVORABLY WITH ORIGINAL ACCEPTANCE TEST DATA ON THESE PARTICULAR VALVES.</p> <p>THE MOST PROBABLE CAUSE OF THE INADVERTENT CLOSURE WAS THE SHOCK AT SEPARATION FROM THE ADAPTER. APPARENTLY, THE SHOCK IS OF SUFFICIENT MAGNITUDE, DIRECTION, AND LOCATION THAT IT COULD HAVE CAUSED THESE VALVES TO CLOSE. THE APOLLO OPERATIONS HANDBOOK (AOH) WILL BE CHANGED TO INSURE THAT THE CREW CHECK THE PROPELLANT ISOLATION VALVES IMMEDIATELY AFTER SEPARATION AND THAT THEY REOPEN ANY VALVES WHICH MAY HAVE CLOSED.</p>	<p>ORGANIZATION: 5-2490</p> <p>REFERENCES: MSC 5-DAY REPORT, P. 9</p> <p>FINAL FLIGHT REPORT 3-13-69</p> <p>MSC 30-DAY ANOMALY REPORT P 2</p> <p>MSC 60-DAY REPORT-PA-R-69.2 P.17.1</p> <p>RESOLUTION: CLOSED</p> <p>DATE 6-13-69</p> <p>REV:</p>
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DETAIL SHEET

ANOMALY 2.1.1.1

TITLE: PROPELLANT ISOLATION VALVE CLOSURE

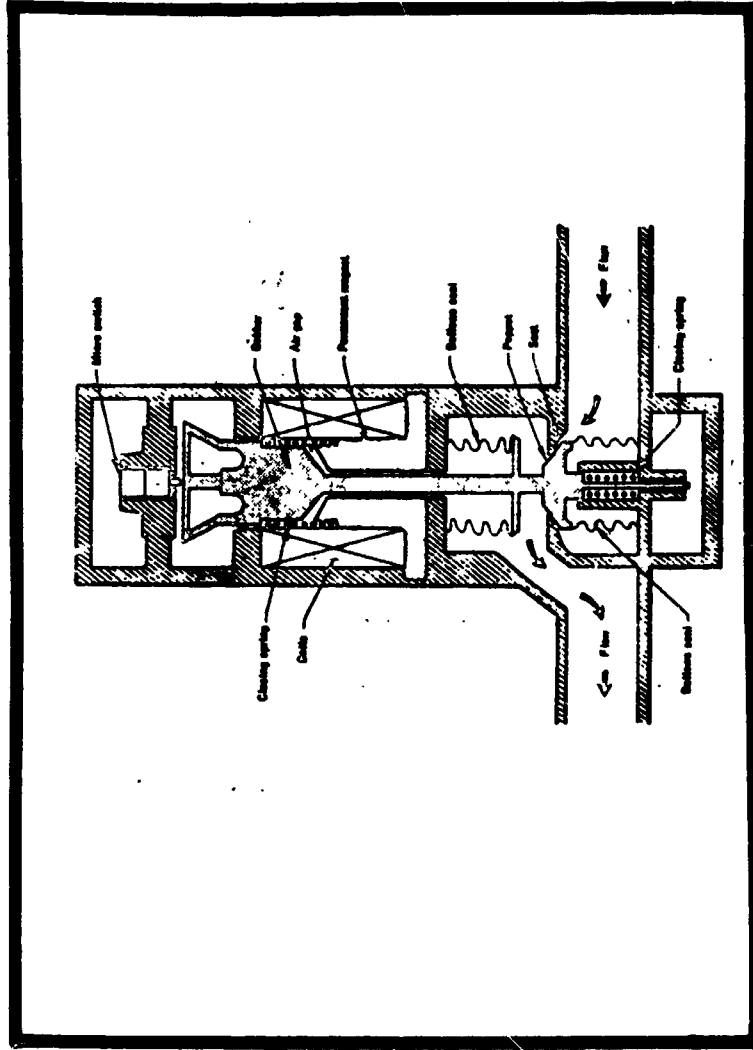


FIG. 2.1.1-1 CROSS SECTION OF REACTION CONTROL SYSTEM ISOLATION VALVE

ANOMALY 2.1.1

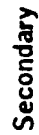


FIG. 2.1.1-2 REACTION CONTROL ISOLATION VALVE

ANOMALY REPORT

NO. 2.1.2	TITLE: INDICATED SERVICE PROPULSION PROPELLANT UNBALANCE MISSION: APOLLO 9 EVENT TIME: 25:17:40	
SYSTEM: SM		
SUBSYSTEM: SPS		
PROBLEM:	<p>DURING THE THIRD SPS MANEUVER, EIGHT CAUTION AND WARNING INDICATIONS OCCURRED, CAUSED BY AN APPARENT UNBALANCE MEASURED BY THE PROPELLANT UTILIZATION GAUGING SYSTEM (PUGS). HOWEVER, TANK CROSSEOVERS OCCURRED WITHIN LESS THAN ONE SECOND, INDICATING THAT, IN FACT, THE LIQUID LEVELS WERE ESSENTIALLY BALANCED. UNBALANCE AT THE START OF THE BURN IS ASSOCIATED WITH THE TIME REQUIRED TO SETTLE THE GAUGING SYSTEM FROM ZERO TO THE FIRING "G" LEVEL. THE PUGS WAS DISABLED FOR THE FOURTH, FIFTH AND SIXTH SPS MANEUVERS, WHICH WERE OTHERWISE NOMINAL IN ALL RESPECTS.</p> <p>PUGS WAS USED DURING SPS BURN NO. 7 IN ORDER TO GET ENGINEERING DATA ON THE MALFUNCTION. ALL PERFORMANCE PARAMETERS WERE NORMAL DURING THE MANEUVER, EXCEPT FOR THE PUGS READINGS ON THE OXIDIZER STORAGE TANK. RESULTS OF THE TESTS MADE DURING THIS BURN INDICATE THE OXIDIZER QUANTITY WAS BIASED BY ABOUT 3 PERCENT. THIS ERROR HAS BEEN ISOLATED TO THE PRIMARY PROBE IN THE OXIDIZER STORAGE TANK AND WAS CAUSED BY RESIDUAL OXIDIZER CLINGING TO THE PROBE DURING ZERO POINT CALIBRATION.</p>	
ACTION:	<p>THE ERRONEOUS BIAS CAUSED BY CLINGING PROPELLANT AND DRYING OF THE DIELECTRIC COMPENSATOR IN THE OXIDIZER STORAGE TANK WILL BE PRECLUDED BY PURPOSELY CALIBRATING THE ZERO POINT OF THE PROBE TO MINUS 0.4 PERCENT. ALTHOUGH THIS MAY RESULT IN A SMALL ERROR WHEN THE TANK CONTAINS OXIDIZER, IT WILL PREVENT ERRORS ON THE ORDER OF 1.9 TO 3.0 PERCENT, AS OBSERVED ON THIS FLIGHT. THIS MODIFICATION WILL BE TESTED AT WHITE SANDS BEFORE IT IS INCORPORATED. PROCEDURES HAVE BEEN CHANGED FOR THE CREW TO IGNORE THE UNBALANCE DURING THE FIRST 25 SECONDS OF A FIRING TO ALLOW SUFFICIENT TIME FOR PROPELLANT SETTling. MASTER ALARM AND CAUTION AND WARNING INDICATIONS FROM THE "PUGS" ARE NOT REQUIRED AND THESE FUNCTIONS HAVE BEEN ELIMINATED FROM SPACECRAFT 106 AND SUBSEQUENT.</p>	
ORGANIZATION: REFERENCES:	RESOLUTION: CLOSED DATE: 6-13-69 REV:	
	5-2490 MSC 5-DAY REPORT, P. 10 FINAL FLIGHT REPORT, 3-13-69 MSC 30-DAY ANOMALY REPORT P. 5 MSC 60-DAY REPORT-PA-R-69-2, P.17.7	

DETAIL SHEET

ANOMALY 2.1.2

TITLE: INDICATED SERVICE PROPULSION PROPELLANT UNBALANCE

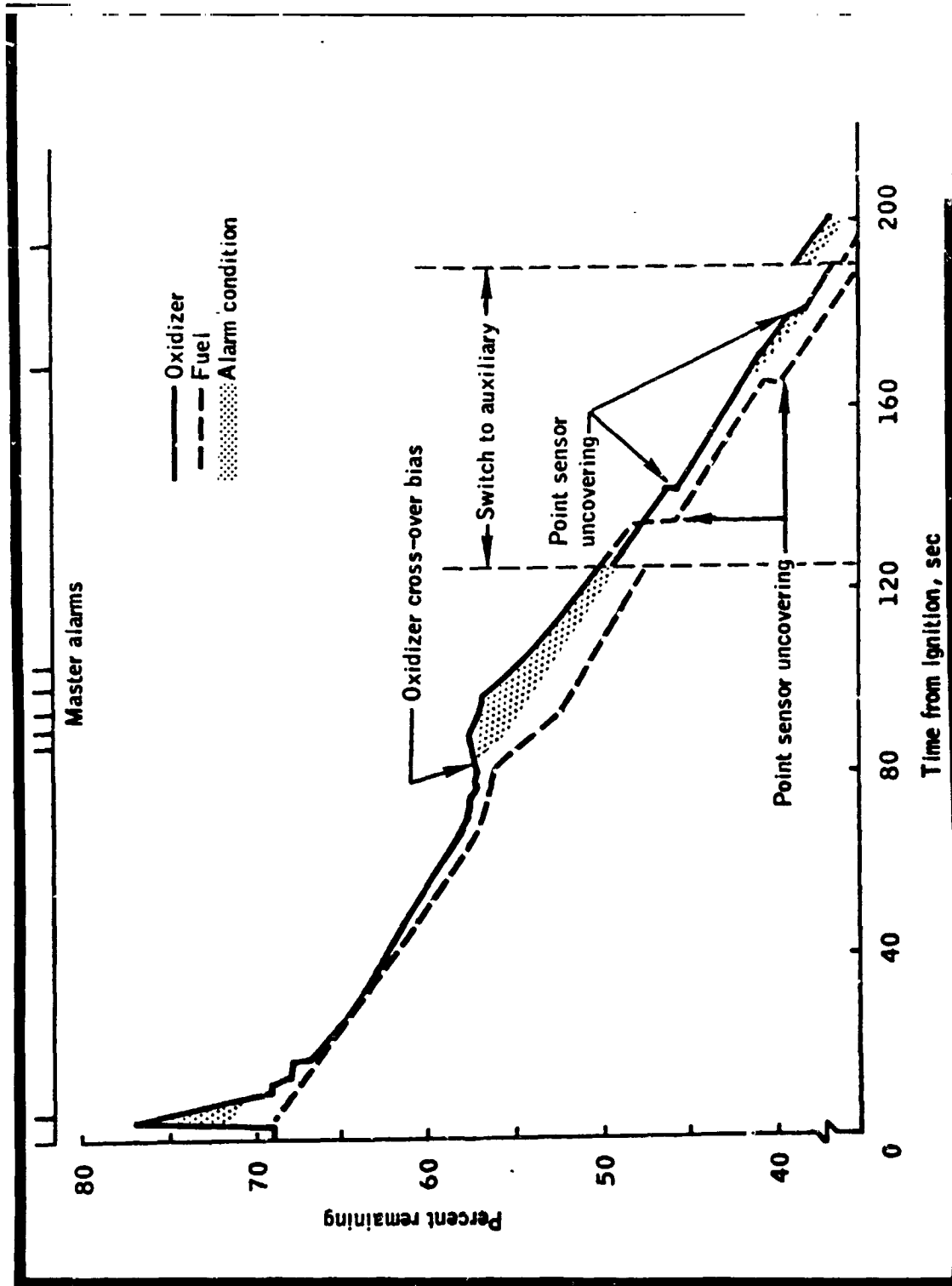


FIG. 2.1.2-1 SERVICE PROPULSION SYSTEM PROPELLANT QUANTITIES

DETAIL SHEET

ANOMALY 2.1.1.2

TITLE: INDICATED SERVICE PROPULSION PROPELLANT UNBALANCE

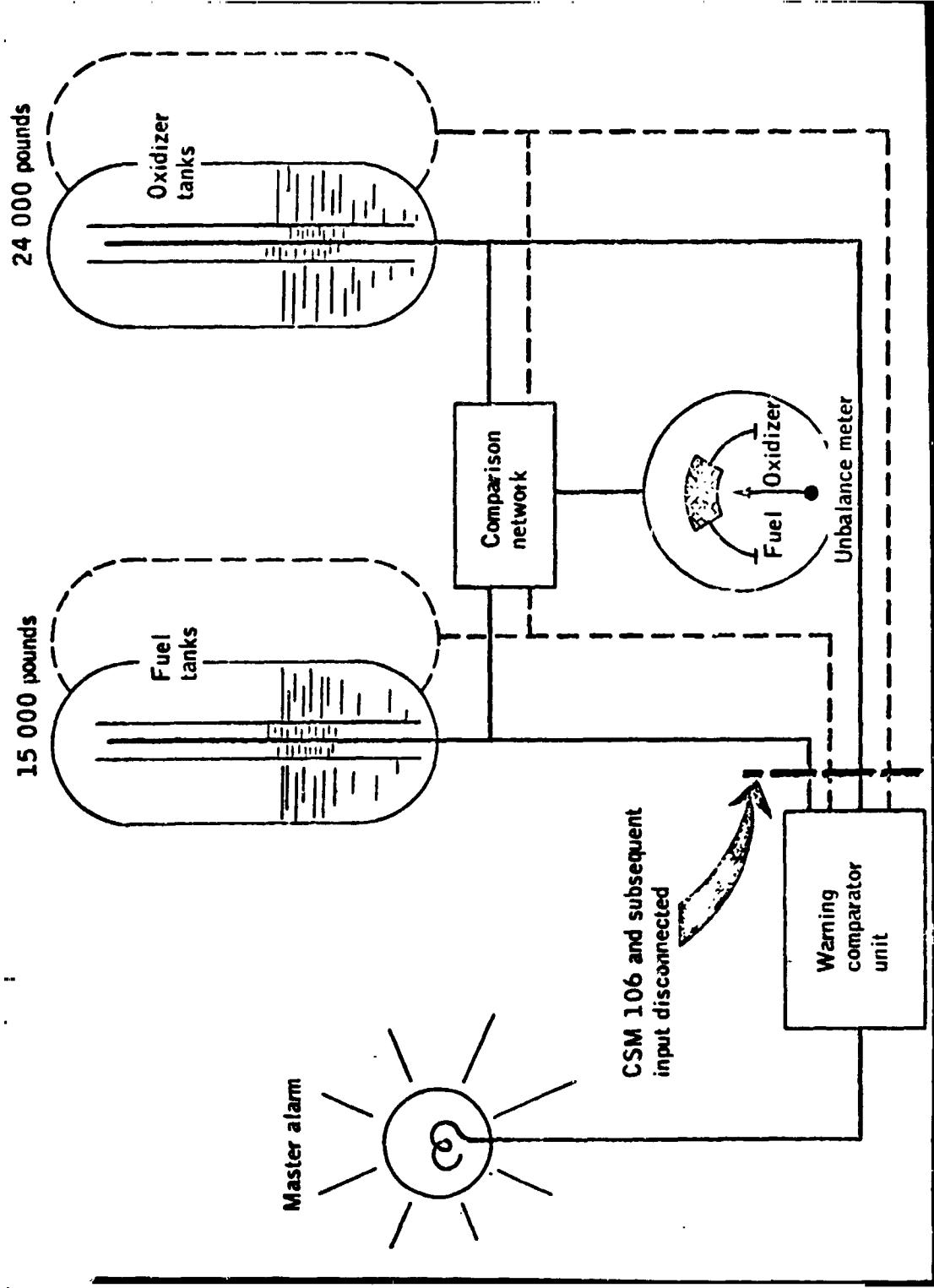


FIG. 2.1.2-2 PRIMARY PROPELLANT UTILIZATION SYSTEM CIRCUIT

ANOMALY REPORT

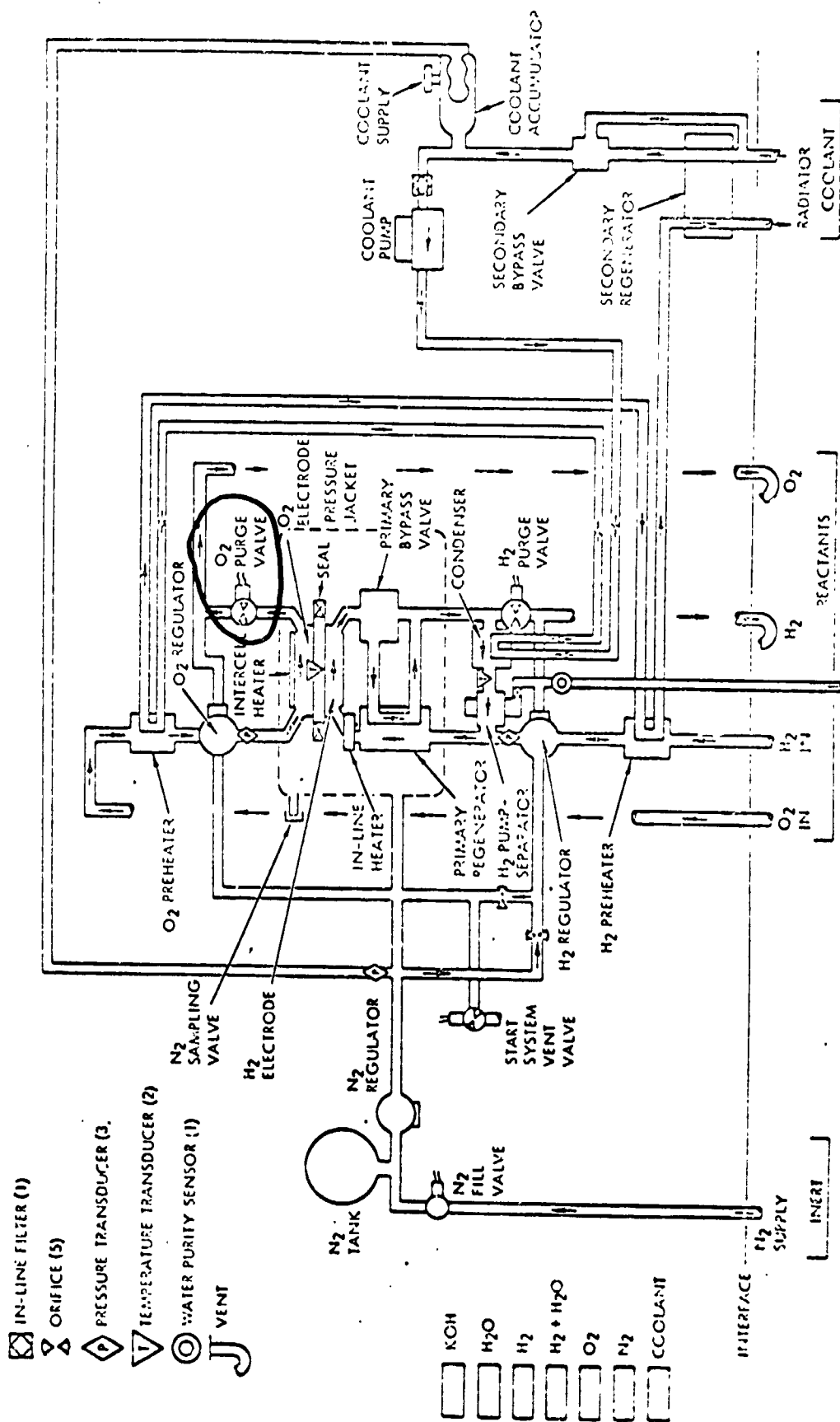
NO. 2.1.1.3	TITLE: HIGH O ₂ FLOW RATE ON FUEL CELL NO. 3	MISSION: APOLLO 9
SYSTEM: CSM		EVENT TIME: 25:18
SUBSYSTEM: ELECTRIC POWER		
<p>PROBLEM: AT 25:26 GET, AFTER SPS BURN NO. 3, THE OXYGEN FLOW RATE TO FUEL CELL NO. 3 WAS HIGH, 0.78 LB/HR. THE INCREASE WAS NOT COMPATIBLE WITH THE INDICATED HYDROGEN FLOW RATE OF 0.072 LB/HR. AT APPROXIMATELY 26:10, FUEL CELL NO. 3 WAS PURGED, AND AT 27:45 THE O₂ FLOW RATE RETURNED TO NORMAL.</p> <p>INDICATIONS ARE THAT FLOW WAS NORMAL TO THE FUEL CELL AND THAT THE FLOW METER WAS ERRATIC; FLOW DATA RETURNED TO NORMAL AT 28:00.</p>		
ACTION:		
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 5-DAY REPORT, P. 8		REV:
		29

DETAIL SHEET

ANOMALY 2.1.1.3

TITLE: HIGH O₂ FLOW RATE ON FUEL CELL NO. 3.

FIG. 2.1.3-1 FUEL CELL NO. 3 DIAGRAM



ANOMALY REPORT

NO. 2.1.4	TITLE: FUEL CELL NO. 2 CONDENSER EXIT TEMPERATURE HIGH SYSTEM: CSM SUBSYSTEM: ELECTRICAL	MISSION: APOLLO 9 EVENT TIME: 89:00			
<p>PROBLEM: AT 62 HOURS, THE CONDENSER EXIT TEMPERATURE OF FUEL CELL 2 DROPPED TO APPROXIMATELY 150°F (NORMAL IS 155° TO 165°F). AT 90.5 HOURS, THE TEMPERATURE PEAKED AT 175°F FOR THE FIRST OF SEVERAL EXCURSIONS OUT OF NORMAL OPERATING TOLERANCES; HOWEVER, THE PARAMETER RECOVERED AT ABOUT 191 HOURS AND REMAINED WITHIN NORMAL LIMITS THEREAFTER.</p> <p>ANALYSIS: A SIMILAR PROBLEM OCCURRED ON APOLLO 7-A STICKING BYPASS VALVE. ANALYSIS SHOWS THAT THE SECONDARY COOLANT REGENERATOR BYPASS VALVE TRAVEL WAS RESTRICTED BETWEEN APPROXIMATELY 4 AND 10 PERCENT BYPASS DURING THIS PERIOD. PREVIOUS GROUND TESTS AND ANALYSIS OF COOLANT DRAINED FROM VIBRATION AND FLUSHING OPERATIONS ON SPACECRAFT 103 AND 104 LEADS TO THE CONCLUSION THAT COOLANT LOOP CONTAMINATION BUILDUP IN THE VALVE WAS THE CAUSE OF THE RESTRICTED TRAVEL OBSERVED ON APOLLO 9. THIS CONTAMINATION IS PRESENT IN THE FORM OF GELATINOUS PHOSPHATES AND/OR SOLID PARTICLES.</p> <p>ACTION: ALL FURTHER FUEL CELLS WILL BE EQUIPPED WITH HIGH TEMPERATURE HYDROGEN PUMPS. NEW PROCEDURES HAVE BEEN INITIATED TO ENSURE CLEANER FLUIDS. THE FACE OF THE BYPASS VALVE WILL BE CHANGED AS USED IN BLOCK I SPACECRAFT TO ELIMINATE THE VALVE SEATING PROBLEM DUE TO DIRTY FLUID AND INCORPORATE VALVE INLET FILTERS ON ALL FUEL CELLS.</p> <p>FOR APOLLO 10, THE RADIATORS WILL BE VIBRATED AND A VOLUME EXCHANGE MADE 30 TO 45 DAYS PRIOR TO LAUNCH (APOLLO 9 HAD ONLY A VOLUME EXCHANGE 45 DAYS PRIOR TO LAUNCH).</p>					
<table style="width: 100%;"> <tr> <td style="width: 30%;"> ORGANIZATION: 5-2490 REFERENCES: MSC 5-DAY REPORT, P. 7 MSC 30-DAY ANOMALY REPORT P-6 MSC 60-DAY REPORT-PA-R-69-2, P. 17-9 </td> <td style="width: 40%; text-align: center;"> RESOLUTION: CLOSED </td> <td style="width: 30%; text-align: right;"> DATE: 6-13-69 REV: </td> </tr> </table>			ORGANIZATION: 5-2490 REFERENCES: MSC 5-DAY REPORT, P. 7 MSC 30-DAY ANOMALY REPORT P-6 MSC 60-DAY REPORT-PA-R-69-2, P. 17-9	RESOLUTION: CLOSED	DATE: 6-13-69 REV:
ORGANIZATION: 5-2490 REFERENCES: MSC 5-DAY REPORT, P. 7 MSC 30-DAY ANOMALY REPORT P-6 MSC 60-DAY REPORT-PA-R-69-2, P. 17-9	RESOLUTION: CLOSED	DATE: 6-13-69 REV:			

ANOMALY REPORT

NO. 2.1. 5	TITLE: LOSS OF AUTOMATIC CRYOGENIC HYDROGEN PRESSURE CONTROL	MISSION: APOLLO 9
SYSTEM: CSM		EVENT TIME: 93:00
SUBSYSTEM: EPS (FUEL CELLS)	<p>PROBLEM: AT 93 HOURS, LH₂ TANK HEATERS FAILED TO COME ON AUTOMATICALLY. AT 101 HOURS, AUTO SYSTEM RECOVERED AND INCREASED PRESSURE BEYOND AUTO CUTOFF SETTING (270°F). HEATING SYSTEM WAS MANUALLY TURNED OFF AT 106 HOURS. PRESSURE CONTROL WAS MAINTAINED BY MANUAL FAN CONTROL FOR REMAINDER OF MISSION.</p> <p>SINCE THE FIRST FAILURE (FAILURE TO TURN ON) WOULD HAVE REQUIRED ONE PRESSURE SWITCH TO FAIL OPEN AND THE SECOND FAILURE (FAILURE TO TURN OFF) WOULD HAVE REQUIRED THAT BOTH PRESSURE SWITCHES FAIL CLOSED, THE SWITCHES CAN BE RULED OUT. THE MOST PROBABLE CAUSE FOR THE FAILURES WAS AN INTERMITTENT CONDITION IN THE MOTOR OR ITS CONTROL CIRCUIT (INCLUDING THE POWER LINE, GROUND, AND THE TERMINAL BOARD FOR 16-GAGE PINS) RESULTING FROM THE UNDOCKING SHOCK (SEE FIG. 5). SIXTEEN-GAGE TERMINAL BOARDS HAVE BEEN THE SOURCE OF INTERMITTENT CONTACT PROBLEMS DURING VEHICLE GROUND TESTS.</p> <p>ACTION: NO CORRECTIVE ACTION WILL BE TAKEN FOR APOLLO 10; THE TANK PRESSURES CAN BE CONTROLLED MANUALLY BE EITHER THE HEATERS OR THE FANS IF THE AUTOMATIC SYSTEM FAILS.</p>	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 30-DAY ANOMALY REPORT P-3 MSC 60-DAY REPORT, PA-R-69-2, P. 17-4		REV:
		32

DETAIL SHEET

ANOMALY 2.1.5

TITLE: LOSS OF AUTOMATIC CRYOGENIC HYDROGEN PRESSURE CONTROL

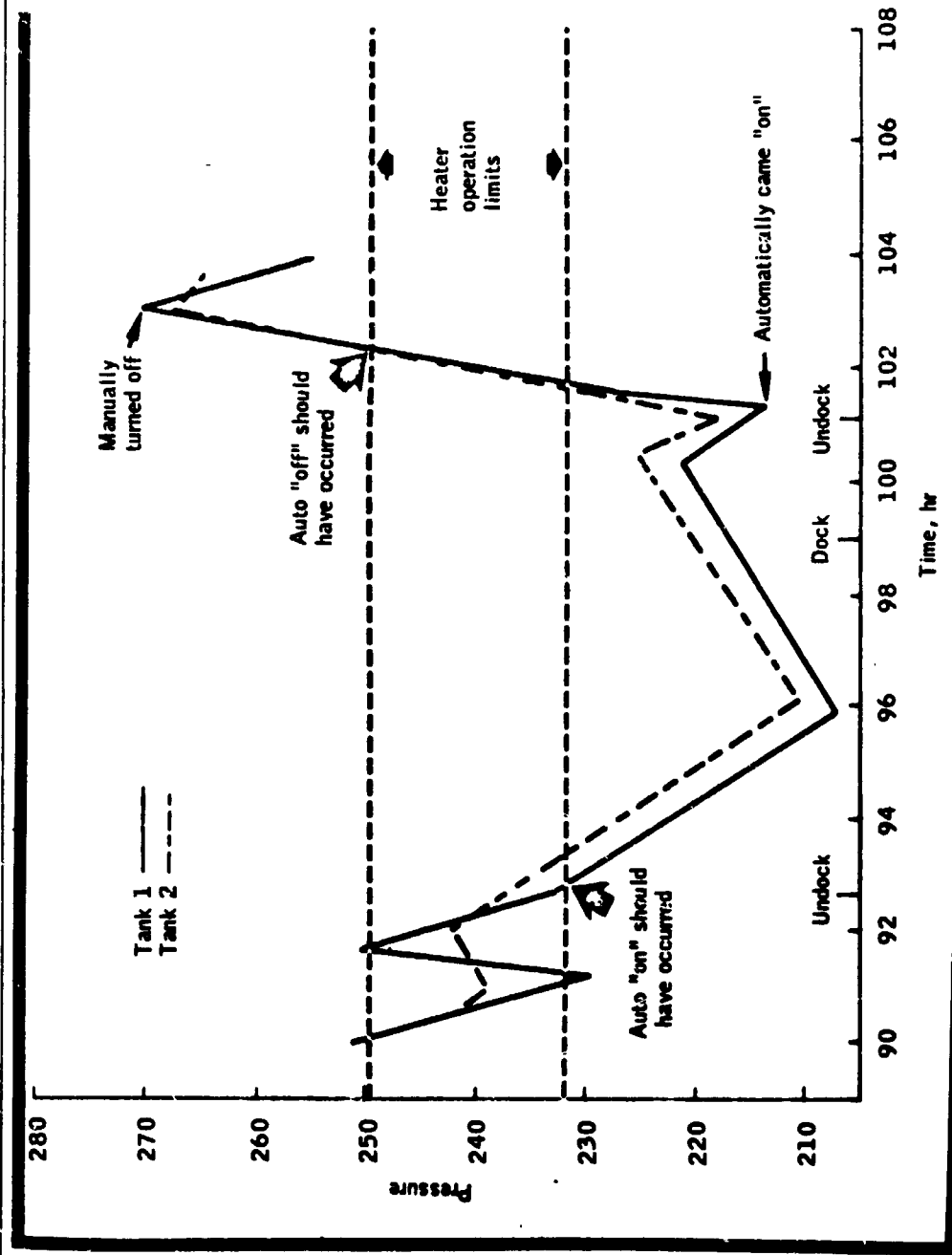


FIG. 2.1.5-1 HYDROGEN TANK PRESSURE-HEATER OPERATION

ANOMALY 2.1.5

TITLE: LOSS OF AUTOMATIC CRYOGENIC HYDROGEN PRESSURE CONTROL

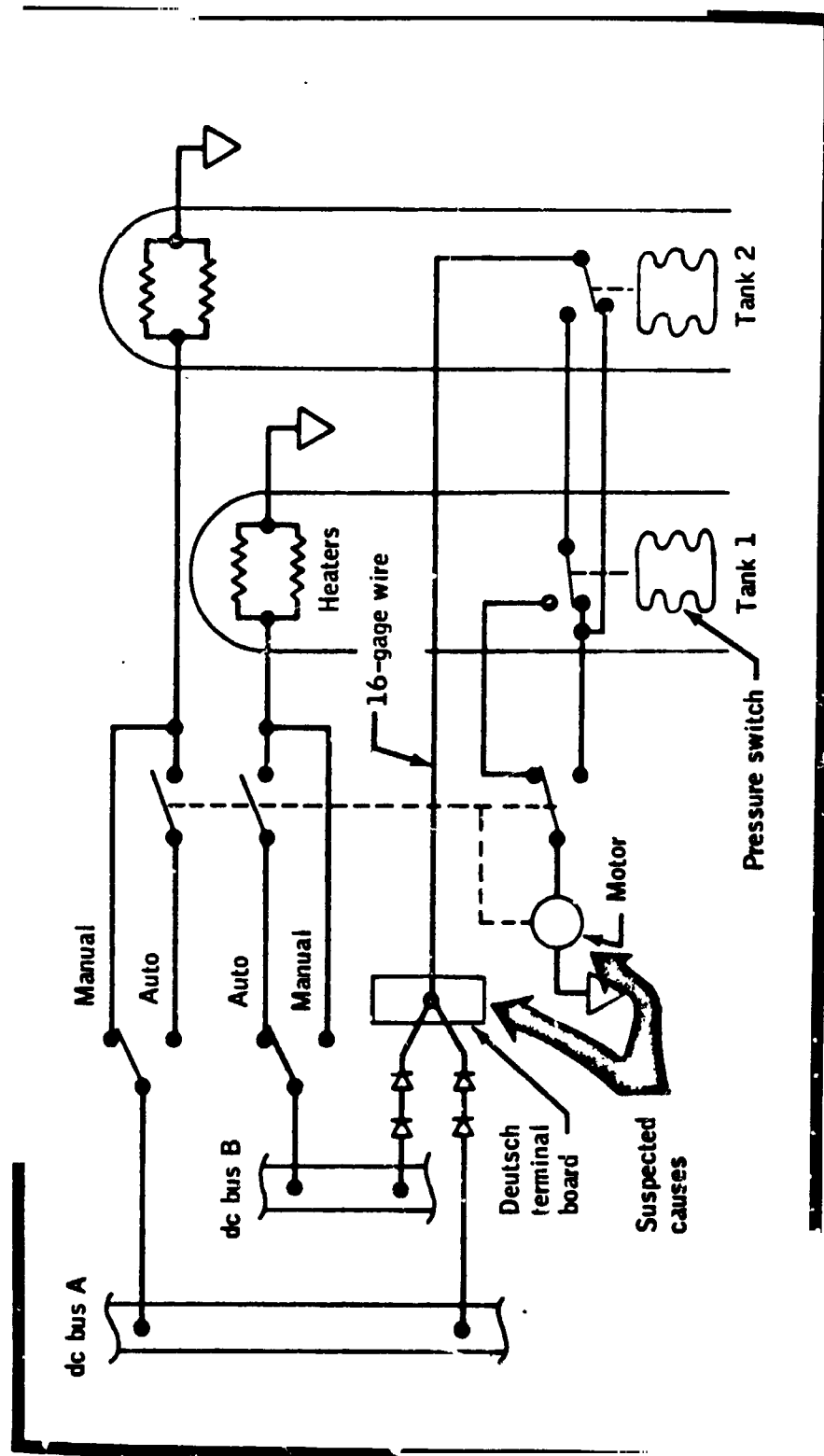


FIG. 2.1.5-2 HYDROGEN TANK PRESSURE CONTROL

ANOMALY REPORT

NO. 2.1.1.6	TITLE: NO VOICE UPLINK COMMUNICATION WITH S/C DURING EVA	
SYSTEM: CM	MISSION: APOLLO 9	
SUBSYSTEM: COMMUNICATIONS	EVENT TIME: 73:30	
PROBLEM:	<p>GROUND TRANSMISSION FROM HOUSTON FLIGHT CONTROLLERS WAS NOT RECEIVED BY THE CREW DURING THE EVA PERIOD.</p> <p>CREW CHECKLIST REQUIRED S-BAND VOLUME FULLY DECREASED, PREVENTING CREW RECEPTION OF S-BAND VOICE. GUAYMAS, TEXAS, MERRITT ISLAND, AND VANGUARD TRACKING STATIONS WERE CONFIGURED FOR S-BAND UPLINK ONLY, THUS EXPLAINING THE LACK OF COMMUNICATIONS FROM THESE SITES. GROUND TRANSMISSIONS THROUGH THE HUNTSVILLE, REDSTONE, AND CANARY ISLANDS, WHICH WERE PROPERLY CONFIGURED, WERE RECEIVED BY THE CREW. THE ONLY TRANSMISSION THROUGH BERMUDA (PROPERLY CONFIGURED ON VHF SIMPLEX-A) OCCURRED SIMULTANEOUS WITH A LM/CSM CONVERSATION WHICH WOULD HAVE CAPTURED BOTH SPACECRAFT AND PLSS RECEIVERS, THUS PREVENTING RECEPTION OF THE GROUND TRANSMISSION. FOUR TRANSMISSIONS THROUGH BERMUDA ON VHF SIMPLEX-B WERE ON THE SAME FREQUENCY THE EVA WAS USING CONTINUOUSLY; HENCE, RECEIPT OF THESE TRANSMISSIONS WOULD NOT BE EXPECTED.</p> <p>ADEQUATE COMMUNICATIONS WERE MAINTAINED DURING EVA VIA VHF SIMPLEX.</p>	
ACTION:	<p>NONE REQUIRED - EVA ON FUTURE MISSIONS WILL BE ON THE LUNAR SURFACE USING S-BAND FOR GROUND/CREW COMMUNICATION.</p>	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 5-DAY REPORT, P. 5		REV:
		35

ANOMALY REPORT

NO. 2.1.7	TITLE: UPLINK COMMANDS NOT ACCEPTED	MISSION: APOLLO 9
SYSTEM: CM		EVENT TIME: 108:42
SUBSYSTEM: COMMUNICATIONS		
PROBLEM:	<p>AT APPROXIMATELY 109 HOURS, THE SPACECRAFT WOULD NOT RESPOND TO MULTIPLE UPLINK REAL-TIME COMMANDS. THIS CONDITION EXISTED UNTIL THE CREW CYCLED THE UP-TELEMETRY COMMAND RESET SWITCH @ ABOUT 118:45:00, RESTORING NORMAL OPERATION.</p> <p>THE FIRST OF MULTIPLE COMMANDS WAS RECEIVED BY THE COMMAND RECEIVER; HOWEVER, A MESSAGE ACCEPTANCE PULSE WAS NOT TRANSMITTED TO THE GROUND RECEIVER, WHICH IN TURN SENDS A SIGNAL TO THE GROUND TRANSMITTER TO SEND THE NEXT COMMAND. THE GROUND OVERRIDE FUNCTION WAS USED ON SEVERAL OCCASIONS TO TRANSMIT THE NEXT COMMAND; HOWEVER, THE SPACECRAFT STILL DID NOT RESPOND. THE PROBLEM EXISTED OVER NUMEROUS GROUND STATIONS AND ALSO WAS EXPERIENCED ONCE DURING PRE-FLIGHT TESTING; CONSEQUENTLY, IT HAS BEEN ISOLATED TO THE FLIGHT HARDWARE.</p>	
ACTION:	<p>A COMPREHENSIVE REVIEW OF DATA HAS BEEN CONDUCTED. AT THIS TIME, NO CONCLUSION CAN BE DRAWN AS TO THE CAUSE OF THE DISCREPANCY. TESTING OF THE SPACECRAFT UPDATA LINK HARDWARE HAS NOT IDENTIFIED ANY PROBLEMS.</p> <p>NO CORRECTIVE ACTION IS ANTICIPATED FOR SPACECRAFT 106.</p>	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 30-DAY ANOMALY REPORT P-4		REV:
MSC 60-DAY REPORT, PA-R-69-2, P. 17-5		
36		

ANOMALY REPORT

<p>NO. 2.1.8</p> <p>SYSTEM: CM</p> <p>SUBSYSTEM: CAUTION AND WARNING</p>	<p>TITLE: MASTER ALARM AT DOCKING</p> <p>MISSION: APOLLO 9</p> <p>EVENT TIME: 03:02:00</p> <p>PROBLEM:</p> <p>AT 3:02 GET, THE CREW REPORTED A CAUTION AND WARNING MASTER ALARM AT DOCKING (BETWEEN INITIAL CONTACT AND HARD DOCKING) REPORTS FROM KSC INDICATE THAT A SIMILAR ALARM OCCURRED DURING TEST WITH CM 106/LM 4. DATA PLAYBACK AT MSC DID NOT CONFIRM THE MASTER ALARM AND NO DISCREPANCIES HAVE BEEN IDENTIFIED TO EXPLAIN THIS CONDITION.</p> <p>THE FACT THAT THE ALARM DID NOT OCCUR AT PHYSICAL CONTACT BUT DURING THE HARD DOCKING RULES OUT STATIC DISCHARGE BETWEEN THE TWO VEHICLES AND INDICATES A SHOCK-SENSITIVE CONDITION. THE MASTER ALARM SYSTEM IS VERY SENSITIVE TO TRIGGER SIGNALS AND REQUIRES ONLY A 5-MICRO-SECOND PULSE TO INITIATE AN ALARM. THE CAUTION AND WARNING LIGHTS REQUIRE A CONTINUOUS INPUT TO ILLUMINATE. A SHOCK-SENSITIVE INTERMITTENT CONDITION IN ONE OF ABOUT 60 INPUTS COULD TRIGGER THE ALARM.</p> <p>ACTION:</p> <p>THE CAUTION AND WARNING SYSTEM HAS BEEN REMOVED FOR TESTING TO DETERMINE WHETHER ANY OF THE COMPONENTS ARE SHOCK-SENSITIVE OR WHETHER ANY OUT-OF-TOLERANCE CONDITION EXISTS.</p> <p>DURING DOCKING TESTS AT THE LAUNCH SITE, THREE UNEXPLAINED MASTER ALARMS WERE EXPERIENCED ON SPACECRAFT 106. ONE WAS ASSOCIATED WITH ACTUAL CONTACT OF THE LUNAR MODULE WITH THE COMMAND AND SERVICE MODULE. THEREFORE, A RECURRENCE IS LIKELY DURING THE APOLLO 10 MISSION. NO CORRECTIVE ACTION IS ANTICIPATED FOR APOLLO 10 AT THIS TIME.</p>	<p>ORGANIZATION: 5-2490</p> <p>REFERENCES: MSC 5-DAY REPORT, P. 8 FINAL FLIGHT REPORT 3-13-69 MSC 30-DAY ANOMALY REPORT P-6 MSC 60-DAY REPORT, PA-R-69-2, P. 17-8</p> <p>RESOLUTION: CLOSED</p> <p>DATE: 6-13-69</p> <p>REV:</p>
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ANOMALY REPORT

NO. 2.1.1.9	TITLE: SPACECRAFT DISPLAY SPS HELIUM PRESSURE WENT TO ZERO DURING LIFTOFF	MISSION: APOLLO 9
SYSTEM: SM		EVENT TIME: 00:04
SUBSYSTEM: INSTRUMENTATION	PROBLEM: SPACECRAFT SPS HELIUM PRESSURE INDICATIONS WENT TO ZERO AT LIFTOFF. TELEMETRY READINGS ON THE GROUND INDICATED THAT THE PRESSURE WAS NORMAL. THIS ANOMALY HAS BEEN ATTRIBUTED TO ONBOARD INSTRUMENTATION. SPS BURN NO. 1 VERIFIED THAT THE SPS OPERATED NOMINALLY. FAILURE OF TRANSDUCER T-76 OR SIGNAL CONDITIONER IN THE SM IS A SUSPECT CAUSE OF THE ANOMALY. THE REDUNDANT TRANSDUCER PROVIDED SATISFACTORY DATA.	
ACTION: CM 104 WAS RETURNED TO NORTH AMERICAN FOR FAILURE ANALYSIS.		
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 5-DAY REPORT, P. 8		REV:
		38

ANOMALY REPORT

NO. 2.1.10	TITLE: ERROR IN COMMAND MODULE COMPUTER ORBIT CALCULATION	
SYSTEM: CM	MISSION: APOLLO 9	
SUBSYSTEM: PGNC	EVENT TIME: 00:20	
PROBLEM:	<p>THE INITIAL ORBIT INDICATED BY THE COMMAND MODUL COMPUTER (CMC) WAS 89.5×103.0 NAUTICAL MILES (NM) AND THE 3ROUND-COMPUTED ORBIT WAS 102.3×103.9 NM. ALTHOUGH IT WAS SUBSEQUENTLY FOUND THAT THE CMC ACCELEROMETER BIAS VALUE WAS NOT AT THE PRE-LAUNCH MEASURED VALUE, THE INSTRUMENT APPEARS TO BE STABLE AROUND THE POST-LAUNCH READING.</p> <p>THE CAUSE OF THESE DIFFERENCES WAS ISOLATED TO A CHANGE IN X-AXIS ACCELEROMETER BIAS IN THE FINAL COUNTDOWN PERIOD. THIS BIAS CHANGE CAUSED A MISALIGNMENT DURING PRE-LAUNCH GYROCOMPASSING, AS WELL AS A DIRECT DOWNRANGE VELOCITY ERROR DURING ASCENT. THE BIAS COMPENSATION WAS UPDATED IN FLIGHT AND REMAINED STABLE FOR THE REMAINDER OF THE MISSION.</p>	
ACTION:	NONE REQUIRED.	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 5-DAY REPORT, P.8		REV:
		39

DETAIL SHEET

ANOMALY 2.1.10

TITLE: ERROR IN COMMAND MODULE COMPUTER ORBIT CALCULATION

BACKGROUND: THIS ANOMALY IS CLOSED (NORMAL OPERATION). THE ANOMALY OCCURRED BECAUSE OF A NORMAL BIAS SHIFT IN THE PIPA, I.E. BIAS SHIFT WAS WITHIN ALLOWABLE SPECIFICATION LIMITS. COMPUTER OPERATION WAS SATISFACTORY AFTER PIPA BIAS WAS CHANGED. THE 0.4-SECOND LATE ANOMALY ALSO REPORTED WAS SUBSEQUENTLY RESOLVED AS NORMAL OPERATION. BECAUSE THE INITIALIZATION PULSE FOR THE PIPA IS SAMPLED AT 0.5 SECOND INTERVALS, A 0.4-SECOND LATE START, THEREFORE, COULD BE EXPECTED.

ANOMALY REPORT

NO. 2.1.1.11	TITLE: SCANNING TELESCOPE SHAFT DRIVE PROBLEM	MISSION: APOLLO 9
		EVENT TIME: 43:30
SYSTEM: CM		
SUBSYSTEM: G&N OPTICS		
PROBLEM:	<p>CREW MENTIONED PROBLEM WITH CM G&N OPTICS. THE "DEGREES" DRUM OF THE TELESCOPE SHAFT ANGEL COUNTER ON THE OPTICS CONTROL PANEL FROZE AT 64° ON THE FIRST DAY OF THE MISSION. THE "TENTHS" DRUM CONTINUED TO ROTATE (ANGLE READOUT COUNTER-TPAC). ON OTHER OCCASIONS, THE UNIT STUCK SUCH THAT MANIPULATION USING THE UNIVERSAL TOOL WAS REQUIRED BEFORE OPERATION COULD BE RESUMED. THE SEXTANT WAS NOT AFFECTED AND REMAINED FULLY OPERATIONAL THROUGHOUT THE MISSION. PROBLEM WAS A NUISANCE ONLY, AND HAD NO EFFECT ON SYSTEM OPERATIONAL CAPABILITY.</p>	
ACTION:	<p>THE OPTICAL UNIT ASSEMBLY WAS REMOVED FROM THE SPACECRAFT, ELECTRICAL DRIVE TESTS SHOWED THAT THE DRIVE MECHANISM WAS FREE. WHEN UNIT WAS DISASSEMBLED, A PIN WAS FOUND WEDGED IN A SPLIT GEAR ON THE ONE SPEED RESOLVER DRIVE SHAFT IN THE TELESCOPE GEAR BOX. THE PIN WAS ORIGINALLY LOCATED IN THE "TENTHS" DRUM OF THE COUNTER AND IS USED TO ENGAGE A GENEVA MECHANISM AND THEREBY DRIVE THE HIGHER ORDER DRUMS.</p> <p>THE PROBLEM HAS BEEN IDENTIFIED AS AN OUT-OF-TOLERANCE CONDITION ON THE HOLE INTO WHICH THE PIN WAS PRESS-FIT. ANALYSIS OF THE COUNTER AND A TOLERANCE STUDY OF THE PIN/HOLE INTERFACE INDICATES THE DESIGN IS ADEQUATE. THE COUNTERS FOR COMMAND MODULE 106 AND LUNAR MODULE 5 HAVE BEEN REPLACED WITH UNITS THAT HAVE BEEN PROPERLY INSPECTED. SUBSEQUENT COMMAND MODULE AND LUNAR MODULE COUNTERS WILL ALSO BE REPLACED.</p>	
ORGANIZATION:	5-2490	
REFERENCES:	MSC 5-DAY REPORT, P. 8 & 16 MSC 30-DAY ANOMALY REPORT P-2 MSC 60-DAY REPORT, PA-R-69-2, P. 17-3	
	RESOLUTION: CLOSED	DATE: 6-13-69
		REV:
		41

DETAIL SHEET

ANOMALY 2.1.1.11

TITLE: SCANNING TELESCOPE DRIVE SHAFT PROBLEM

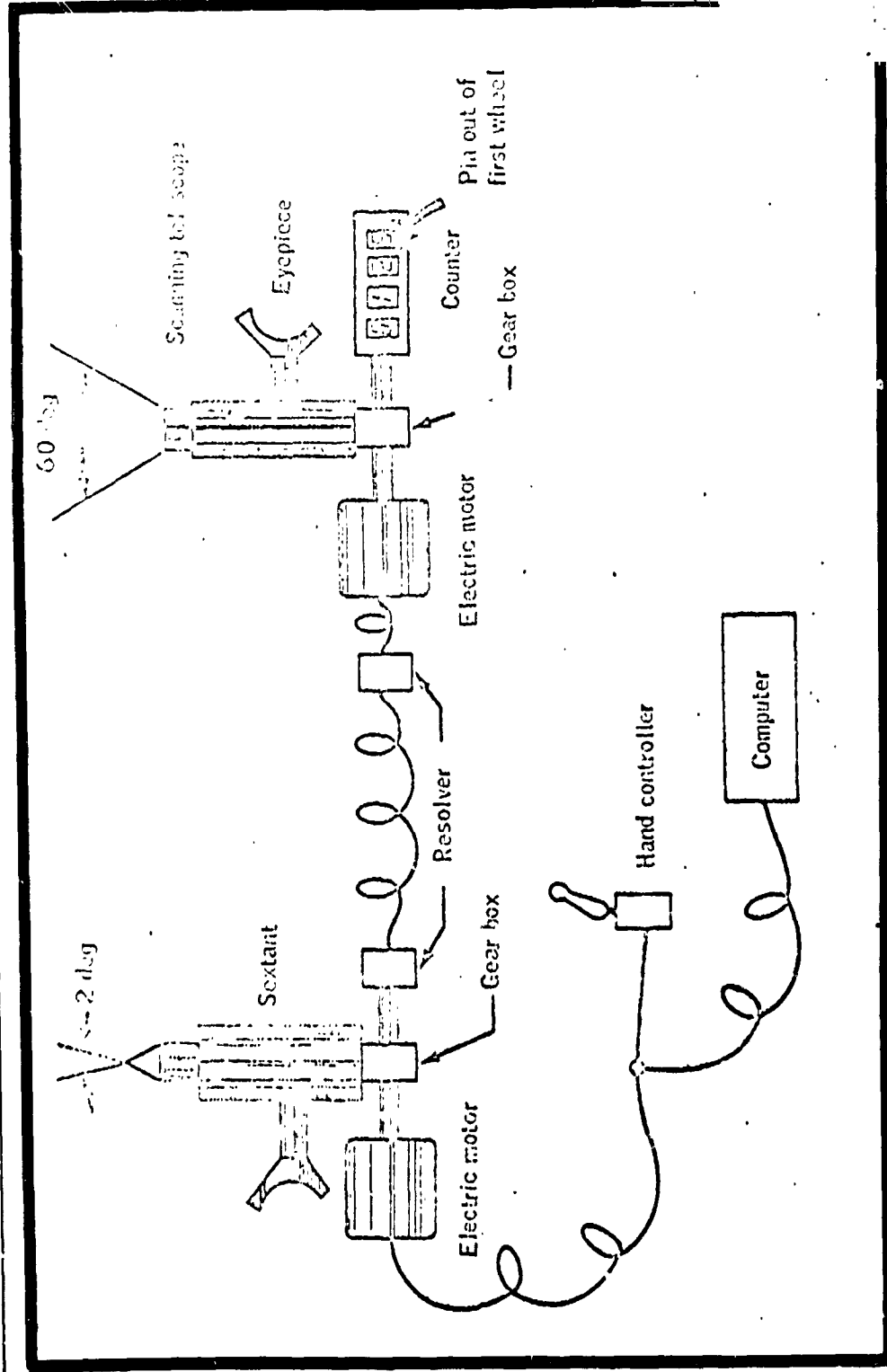


FIG. 2.1.11-1 SCANNING TELESCOPE CIRCUIT

DETAIL SHEET

ANOMALY 2.1.11

TITLE: SCANNING TELESCOPE SHAFT DRIVE PROBLEM

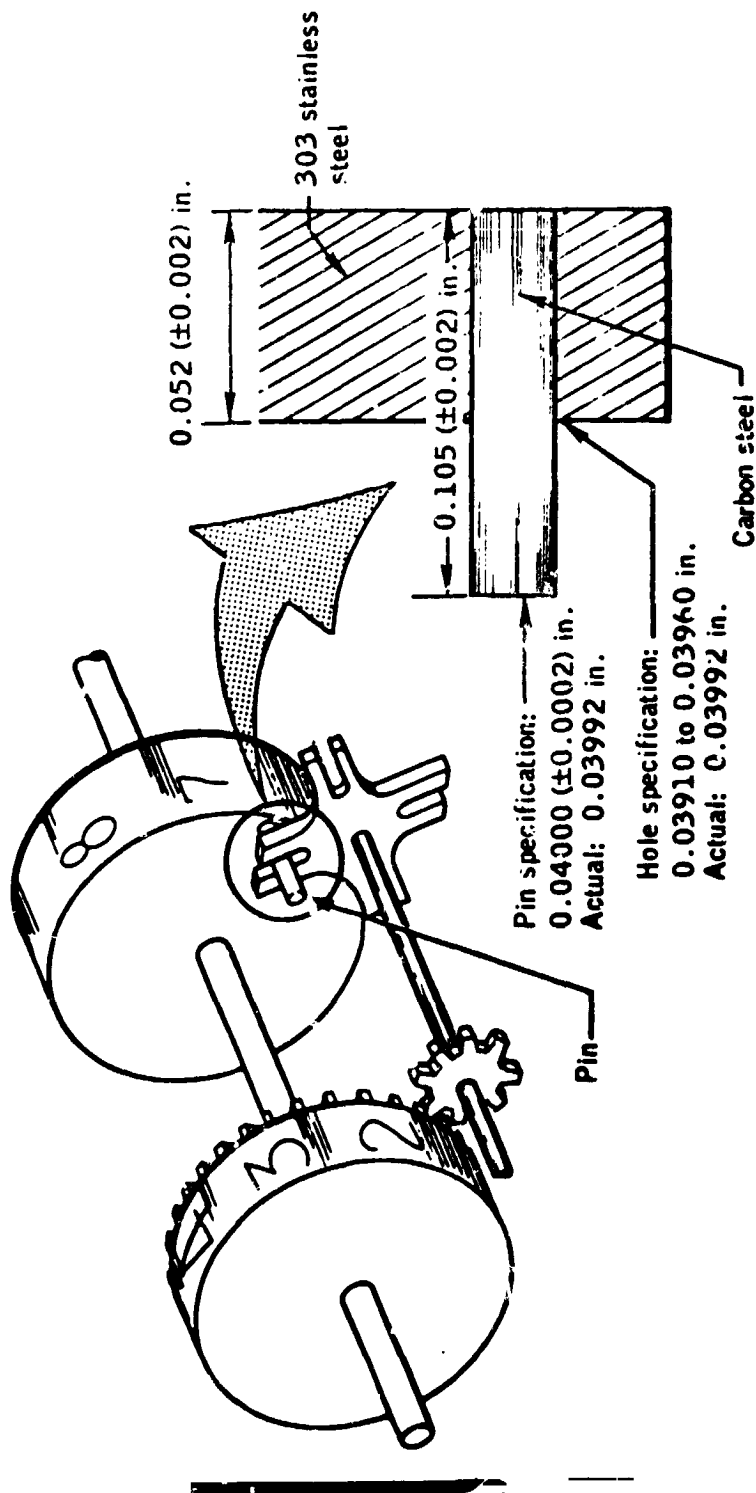


FIG. 2.1.11-2 SCANNING TELESCOPE - COUNTER SHAFT

ANOMALY REPORT

NO. 2.1.1.2	TITLE: ERRONEOUS DOCKING PROBE INDICATIONS
SYSTEM. CM	MISSION: APOLLO 9
SUBSYSTEM: INSTRUMENTATION	EVENT TIME: 92:38 & 98:50
PROBLEM:	<p>DURING INITIAL UNDOCKING, THE COMMAND MODULE PILOT PLACED THE PROBE-EXTEND/RELEASE - RETRACT SWITCH TO EXTEND/RELEASE, AND THE VEHICLES BEGAN TO SEPARATE, INDICATING RELEASE OF THE PROBE-EXTEND LATCH. HOWEVER, THE VEHICLES DID NOT PHYSICALLY SEPARATE BECAUSE THE SWITCH WAS NOT HELD IN THE EXTEND/RELEASE POSITION LONG ENOUGH AND THE PROBE-CAPTURE LATCHES REMAINED IN THE LOCKED CONFIGURATION. RECYCLING OF THE SWITCH COMPLETED THE PROBE EXTENSION, AND NORMAL UNDOCKING WAS ACHIEVED.</p> <p>PRIOR TO THE LUNAR MODULE DOCKING MANEUVER, THE COMMAND MODULE PILOT PLACED THE SWITCH IN THE RETRACT POSITION IN PREPARATION FOR DOCKING. WITH THE SWITCH IN THIS POSITION, AN INDICATION SHOWED THAT THE PROBE WAS NOT IN THE CORRECT POSITION FOR DOCKING. SWITCHING THROUGH THE EXTEND/RELEASE-RETRACT CYCLE PRODUCED THE NORMAL INDICATION.</p> <p>THE DESIGN WILL NOT ALLOW THE LATCHES TO COCK DURING UNDOCKING IF THE RELEASE MOTORS ARE NOT ENERGIZED SUFFICIENTLY LONG FOR THE LATCHES TO SPRING BACK TO PROPER ATTITUDE FOR COCKING. THE SYSTEM RETURNS TO THE UNCOCKED (LATCHES-LOCKED) CONFIGURATION WHICH EXISTS WHEN DOCKED.</p> <p>THE APOLLO OPERATIONS HANDBOOK (AOH) HAS BEEN CHANGED TO INCLUDE THE REQUIREMENT FOR HOLDING THE EXTEND/RELEASE-RETRACT SWITCH IN THE EXTEND/RELEASE POSITION UNTIL PHYSICAL SEPARATION.</p>
ORGANIZATION: 5-2490	RESOLUTION: CLOSED
REFERENCES: MSC 5 DAY REPORT, P. 6	DATE: 6-13-69
MSC 30-DAY REPORT P-3	REV:
MSC 60-DAY REPORT, PA-R-69-2, P. 17-4	
	44

DETAIL SHEET

ANOMALY 2.1.12

TITLE: ERRONEOUS DOCKING PROBE INDICATIONS

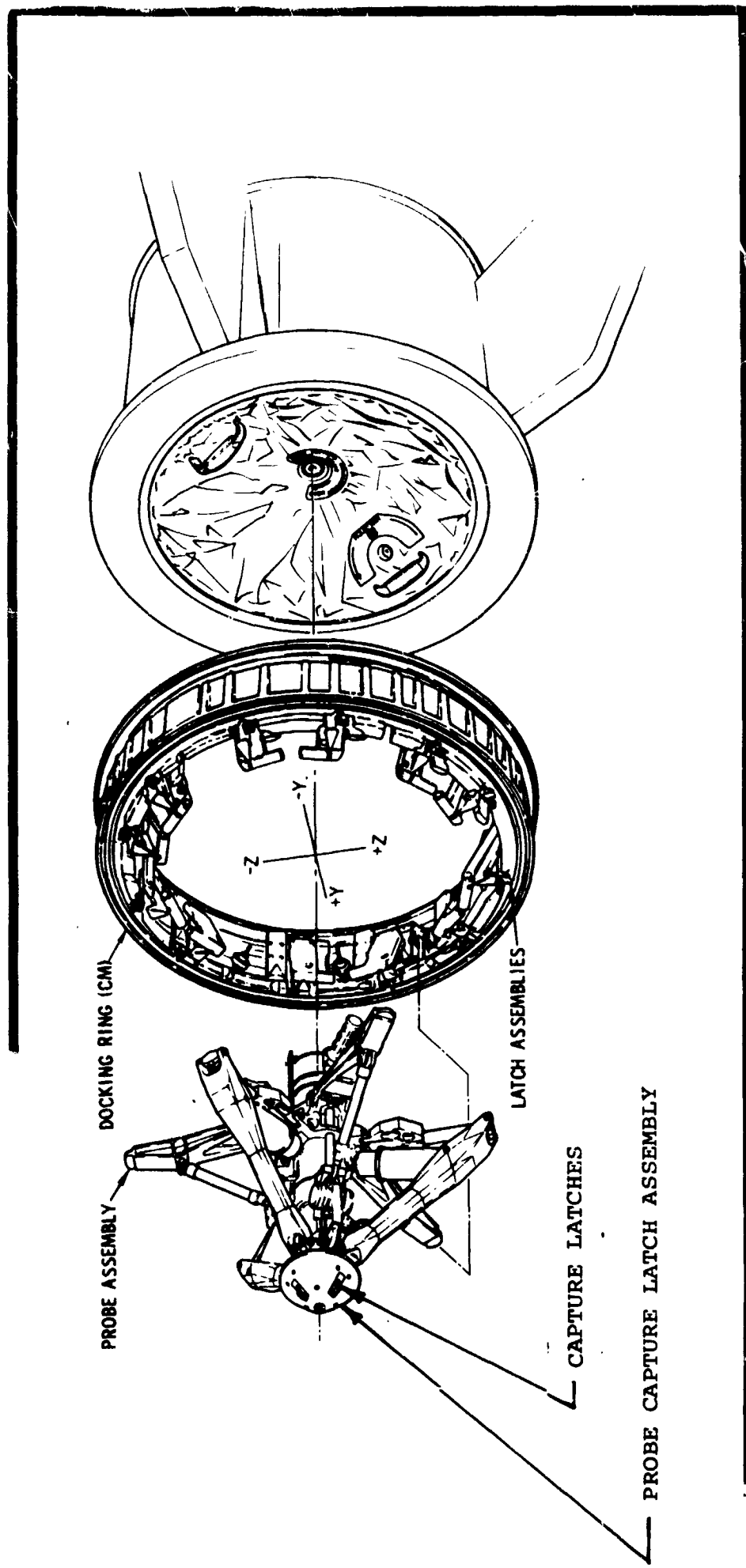
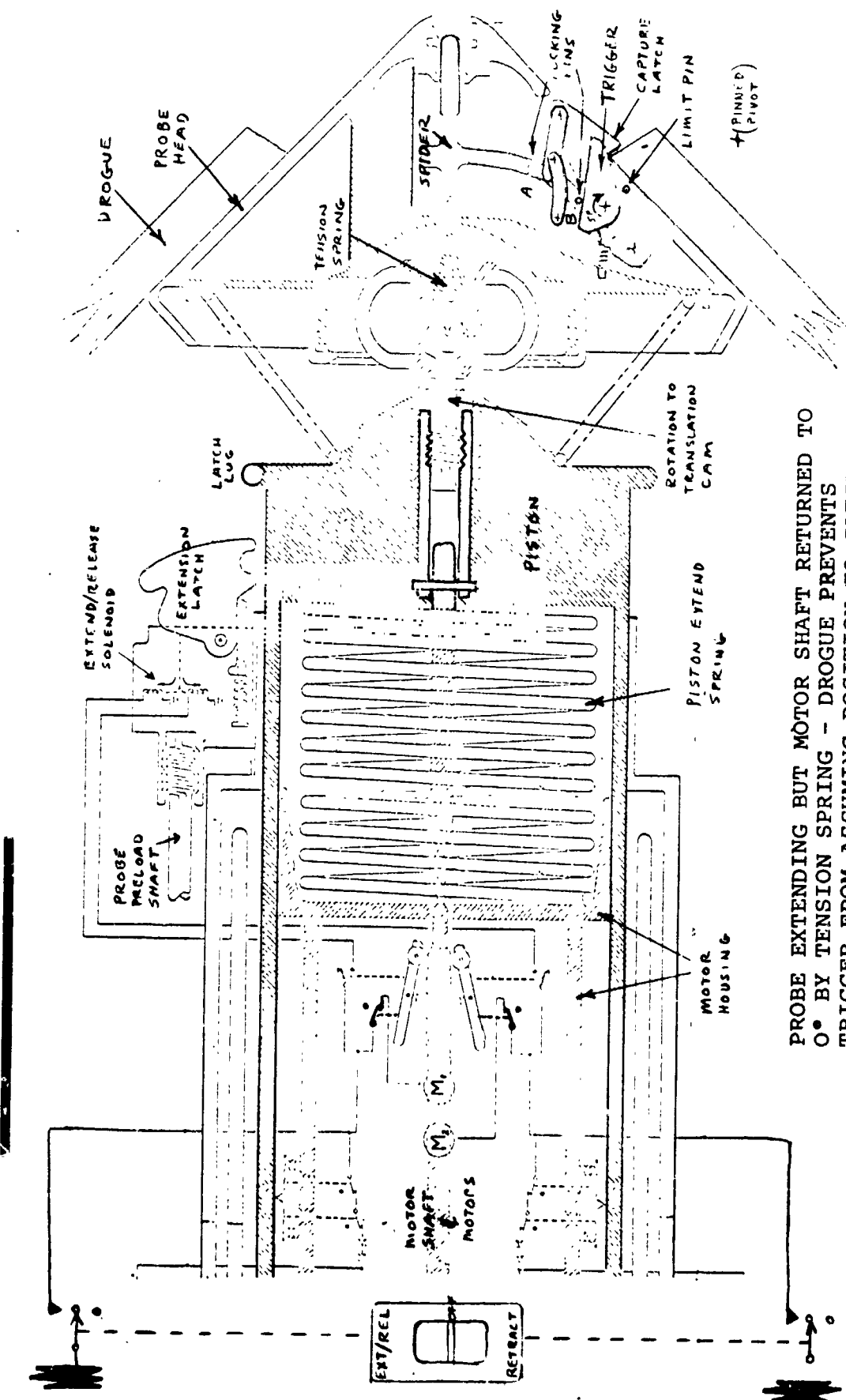


FIG. 2.1.12-1 DOCKING PROBE

DETAIL SHEET

ANOMALY 2.1.12

TITLE: DOCKING PROBE DETAILS FIG. 2.1.12-2



PROBE EXTENDING BUT MOTOR SHAFT RETURNED TO 0° BY TENSION SPRING - DROGUE PREVENTS TRIGGER FROM ASSUMING POSITION TO CATCH LOCK PIN ON SPIDER-THEREFORE, ROLLING LOCKING PIN ON SPIDER HAS RETURNED TO THE CAPTURE-LATCH LOCK POSITION.

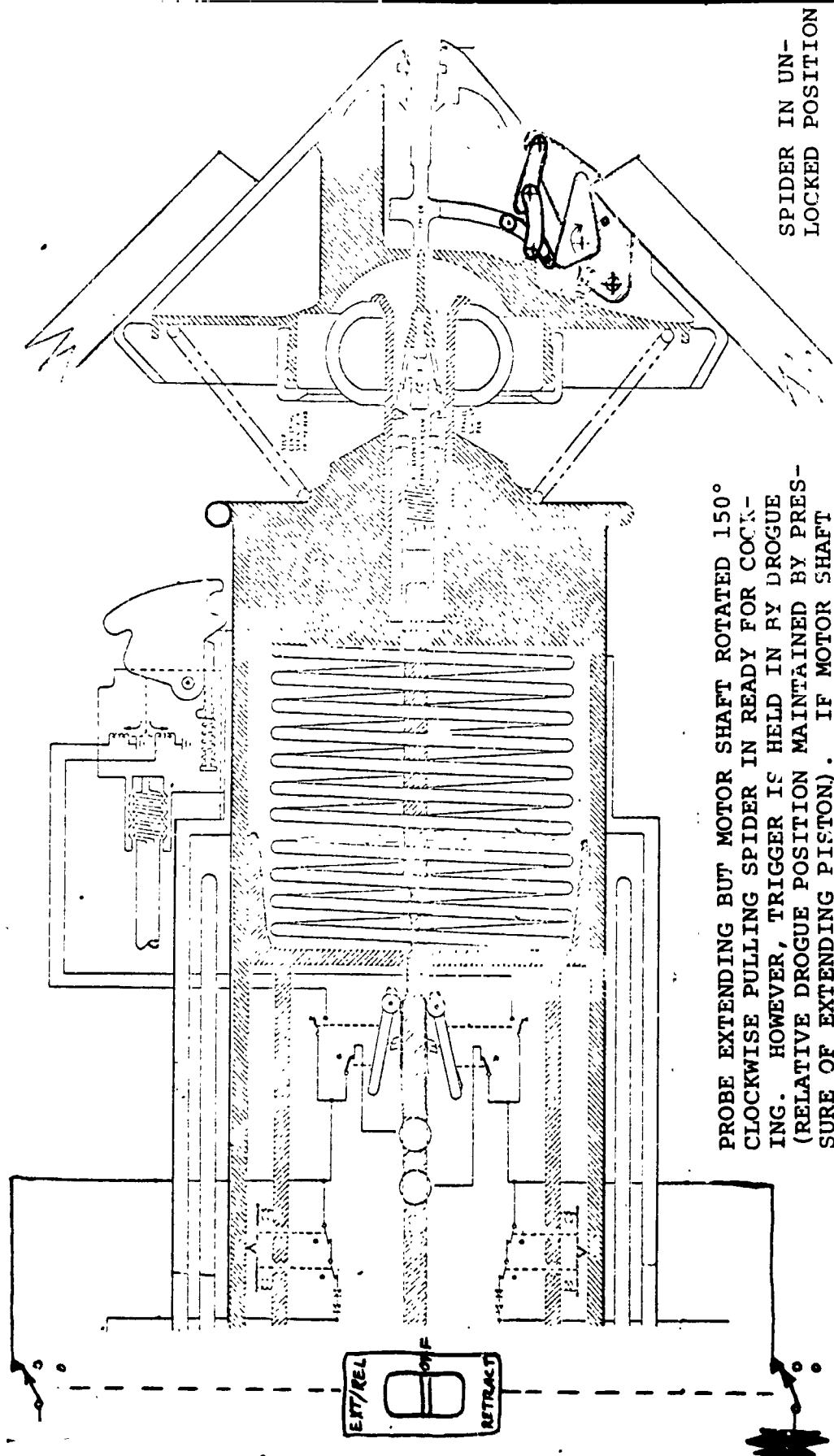
SPIDER IN UN-LOCKED POSITION

DETAIL SHEET

ANOMALY 2.1.12

TITLE. DOCKING PROBE DETAILS

FIG. 2.1.12-3



PROBE EXTENDING BUT MOTOR SHAFT ROTATED 150° CLOCKWISE PULLING SPIDER IN READY FOR COCKING. HOWEVER, TRIGGER IS HELD IN BY DROGUE (RELATIVE DROGUE POSITION MAINTAINED BY PRESURE OF EXTENDING PISTON). IF MOTOR SHAFT IS IN 150° POSITION AT END OF PISTON TRAVEL (10 INCHES), SPACECRAFT WILL UNDOCK. 150° POSITION CAN ONLY BE MAINTAINED AS LONG AS MOMENTARY SWITCH SUPPLIES POWER TO MOTORS, OR IF TRIGGER CAN FREELY SWING BACK TO LIMIT PIN AND CATCH THE SPIDER.

ANOMALY REPORT

NO. 2.1.1.13	TITLE: NO. 1 CABIN FAN OVERHEATED
SYSTEM: CM	MISSION: APOLLO 9
SUBSYSTEM: ECS	EVENT TIME: 164:19
PROBLEM:	CREW REPORTED THAT CABIN FAN NO. 1 DID NOT RUN AND WAS HOT TO THE TOUCH AFTER IT WAS SWITCHED ON AT APPROXIMATELY 164 GET. THE FAN WAS TURNED <u>OFF</u> AND ITS CIRCUIT BREAKER PULLED. CABIN FAN NO. 2 WORKING OKAY.
ACTION:	MSC IS TRACKING THIS DISCREPANCY. FAILURE ANALYSIS WILL BE CONDUCTED ON THE MOTOR AND FAN ASSEMBLY TO DETERMINE THE POST-FLIGHT CONDITION OF THE MOTOR, INSULATION, BEARINGS AND SEALS. THE RATE OF OUTGASSING OF TOXIC FUMES FROM THE MOTOR IN THE STALLED CONDITION WILL ALSO BE ESTABLISHED. PROBLEM NOT CONSIDERED SIGNIFICANT
ORGANIZATION: 5-2490	RESOLUTION: CLOSED
REFERENCES: MSC 5-DAY REPORT, P. 10 VOICE OF APOLLO TAPE ASTRONAUT DEBRIEFING	DATE: 6-13-69 REV:

ANOMALY REPORT

NO. 2.1.14	TITLE: CREW EXERCISER FAILED	MISSION: APOLLO 9
SYSTEM: CM		EVENT TIME: 187:49
SUBSYSTEM: CREW		
PROBLEM:	THE CREW REPORTED THAT THE CREW EXERCISER HAD FAILED. ON THE EIGHTH DAY THE CLIP, WHICH ATTACHED THE ROPE TO THE WEBBING OF THE EXERCISER, FAILED. IN THE POST-FLIGHT MEDICAL DEBRIEFING, THE CREW STATED THAT THE EXERCISER BECAME TOO HOT TO TOUCH DURING ONLY MILD EXERCISE.	
ACTION:	PROBLEM IS CONSIDERED INSIGNIFICANT	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC "APOLLO 9 MISSION REPORT" MSC-PA-R-69-2		REV:
PG. 11-7		
		49

ANOMALY REPORT

NO. 2.1.15	TITLE: PARTIAL LOSS OF BIO-MED DATA	MISSION: APOLLO 9
SYSTEM: CM		EVENT TIME: 119:18
SUBSYSTEM: LIFE SUPPORT		
PROBLEM:	AT 118:13 MCC-H REQUESTED CM CREW TO BEGIN TROUBLESHOOTING BIO-MED HARNESS. PERIODIC BIO-MED DATA DROPOUTS WERE EXPERIENCED AT OTHER TIMES DURING THE MISSION. THE CMP STERNAL ELECTROCARDIOGRAM (SEC) SIGNAL FAILED. HE REPLACED HIS SEC LEAD WITH A SPARE SET. LATER IN THE FLIGHT BOTH THE CDR & LMP EXPERIENCED A SIGNAL LOSS IN THEIR SEC SETS.	
ACTION:	MSC REGARDS THIS DISCREPANCY AS "CLOSED."	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: APOLLO 9 MISSION REPORT		REV:
MSC-PA-R-69-2		
PAGE 11-1		

ANOMALY REPORT

<p>NO. 2.1.1.16</p> <p>SYSTEM: CSM</p> <p>SUBSYSTEM: EMS</p>	<p>TITLE: ENTRY MONITOR SYSTEM (EMS) FAILURE</p> <p>MISSION: APOLLO 9</p> <p>EVENT TIME: ENTRY</p> <p>PROBLEM: DURING THE ENTRY ON APOLLO 9 MISSION, EMS SCRIBE FAILED.</p> <p>ACTION: THE ENTRY MONITOR SYSTEM STYLUS DID NOT CONTINUOUSLY CUT THROUGH THE EMULSION ON THE SCROLL ASSEMBLY. THE ACCELEROMETER OUTPUT OF THE ENTRY MONITOR DRIVES THE STYLUS TO SCRIBE THE ACCELERATION (G) HISTORY.</p> <p>DURING MANUFACTURING, THE SCROLL ASSEMBLY IS PRESSURIZED TO ONE ATMOSPHERE WITH AN INERT GAS TO PREVENT THE FILM EMULSION FROM HARDENING. DURING THE POSTFLIGHT TESTING, A LEAK WAS DETECTED IN THE SCROLL ASSEMBLY, AND IT WAS CONFIRMED THAT THE INERT GAS HAD BECOME DILUTED. FURTHER TESTING REVEALED THAT THE STYLUS TENDED TO EXTEND SLOWLY, APPARENTLY BECAUSE OF FRICTIONAL INTERFERENCE. EXAMINATION OF THE SCROLL REVEALED THAT THE STYLUS HAD TRACED ON THE EMULSION DURING ENTRY BUT WITH INADEQUATE FORCE FOR COMPLETE PENETRATION. BECAUSE OF THE LEAK, THE FILM EMULSION WAS SUBJECTED TO A SLOW VACUUM DRYING DURING THE MISSION, AND IT BECAME HARD. A LEAK-TESTED SCROLL ASSEMBLY, WITH A FINER STYLUS POINT WHICH WILL PENETRATE HARDER EMULSIONS, AND SEVERAL OTHER NOR MODIFICATIONS WILL BE INSTALLED ON APOLLO 10.</p> <p>POST-FLIGHT TESTING OF THE SCROLL ASSEMBLY REVEALED A LEAK AROUND THE BASE OF AN ADJUSTMENT SCREW CUP. CONTAMINATION ON THE STYLUS HOLDER AND BUSHING, CAUSED BY "LOCK-TITE" USED ON THE KEEPER SCREW OF THE STYLUS HOLDER, CAUSED A 2-3 SECOND LAG IN STYLUS RESPONSE. GLYPTOL WILL BE USED ON FUTURE FLIGHTS.</p>
<p>ORGANIZATION: 5-2490</p> <p>REFERENCES: MSC 30-DAY ANOMALY REPORT P-5</p> <p>MSC 60-DAY REPORT, PA-R-69-2, P. 17-6</p>	<p>RESOLUTION: CLOSED</p> <p>DATE: 6-13-69</p> <p>REV:</p>

DETAIL SHEET

ANOMALY 2.1.16

TITLE: ENTRY MONITOR SYSTEM FAILURE

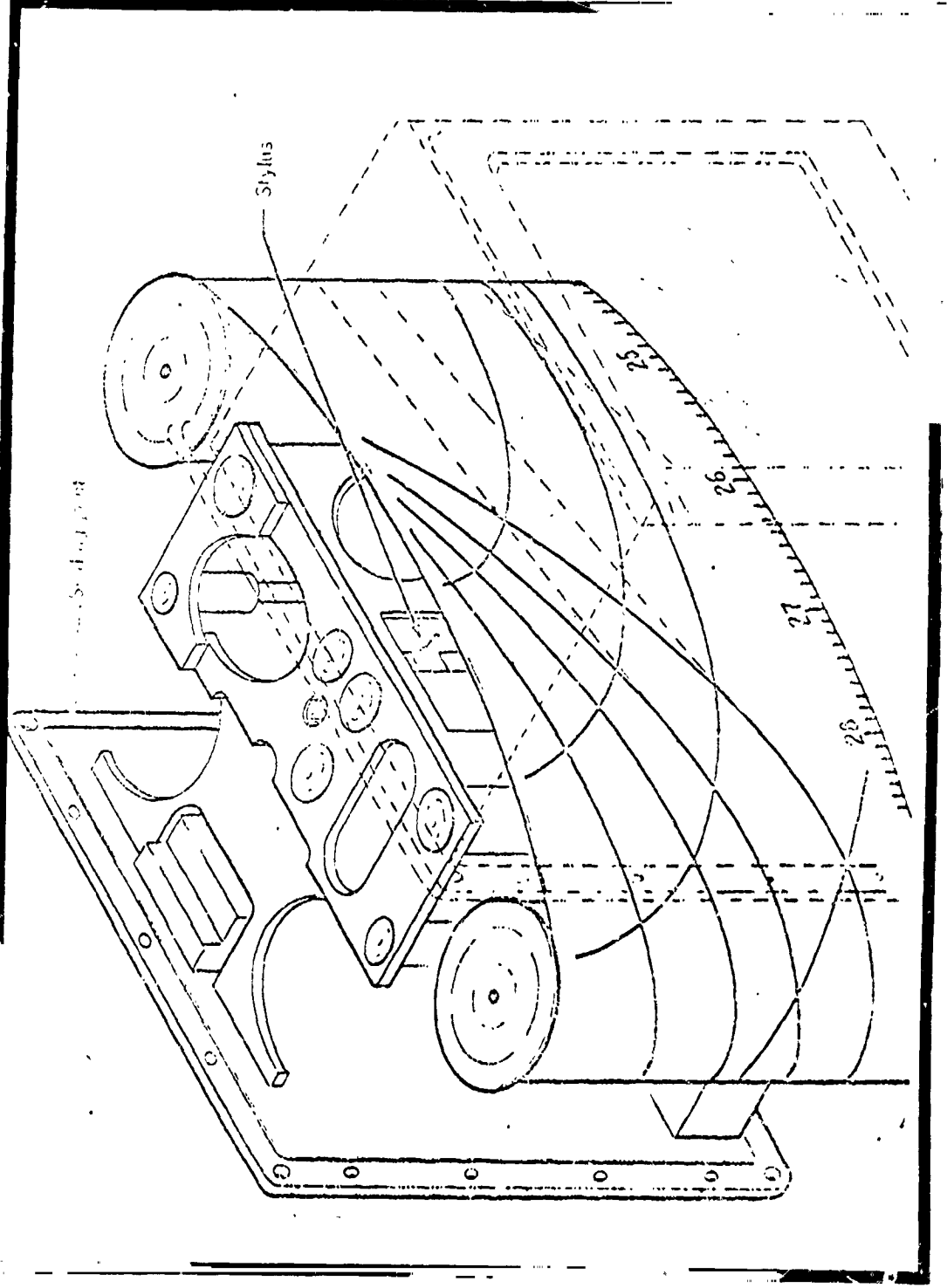


FIG. 2.1.16-1 ENTRY MONITOR

ANOMALY REPORT

NO. 2.1.1.17	TITLE: CENTRAL TIMING RESET TO ZERO	MISSION: APOLLO 9
SYSTEM: CM		EVENT TIME: 168:00
SUBSYSTEM: CENTRAL TIMING		
PROBLEM:	THE CENTRAL TIMING EQUIPMENT EXPERIENCED A RESET TO ZERO AT APPROXIMATELY 168 HOURS AND WAS SUBSEQUENTLY CORRECTED THROUGH THE COMMAND LINK. THE TIMING EQUIPMENT OPERATED PROPERLY THEREAFTER.	
ACTION:	NONE. MSC CONSIDERS THIS AN INSIGNIFICANT PROBLEM CORRECTABLE IN FLIGHT SHOULD IT RECUR.	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 5-DAY REPORT P. 8		REV:
		53

ANOMALY REPORT

NO. 2.1.18	TITLE: BATTERY "B" LOW CAPACITY	MISSION: APOLLO 9
SYSTEM: CSM		EVENT TIME: ORBIT
SUBSYSTEM: ELECTRICAL POWER SYSTEM		
PROBLEM:	BATTERY "B" EXHIBITED A LOW AMPHRE HOUR CAPACITY AT SEPARATION.	
ACTION:	PROBLEM NOT CONSIDERED SIGNIFICANT BY MSC	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 5-DAY REPORT, P. 6		REV:
		54

ANOMALY REPORT

NO. 2.1.1.19	TITLE: COMPUTER RESPONSE TO DSKY ENTRIES	MISSION: APOLLO 9	
		EVENT TIME: ORBIT	
SUBSYSTEM: COMPUTER	<p>PROBLEM: TWO INSTANCES OF THE COMPUTER FAILING TO RESPOND AS EXPECTED OCCURRED DURING THE MISSION. IN ONE INSTANCE, THE COMPUTER OPERATED THROUGHOUT THE NIGHT. THE PROCEDURE TO STOP THE COMPUTER FROM OPERATING IS FOR THE CREW TO ENTER INTO THE DSKY VERB 46 "ENTER." THE CREW VERIFIED THAT THEY HAD DONE THIS.</p> <p>THE SECOND INSTANCE, THE DIGITAL AUTOPILOT COMPUTER LOADING THROUGH THE DSKY FOR THE SIXTH SERVICE PROPULSION MANEUVER, WAS VERIFIED BY THE GROUND READOUTS TO BE PROPER, HOWEVER THE MANEUVER WAS CANCELLED WHEN NO REACTION CONTROL SYSTEM +X TRANSLATION WAS INITIATED.</p> <p>IN BOTH INSTANCES, THE INSERTION OF "ENTER" IS THE FINAL STEP TO ACTIVATE THE COMPUTER. GROUND VERIFICATION OF PROPER COMPUTER LOADING CAN BE MADE EXCEPT FOR "ENTER", WHICH IS NOT TRANSMITTED TO THE GROUND.</p> <p>ACTION: THE TWO OCCURRENCES ARE DIFFERENT IN THAT DIFFERENT FAILURE OR PROCEDURAL ERROR CHARACTERISTICS WOULD BE REQUIRED TO PRODUCE THE REPORTED SYMPTOMS. A DEPRESSION OF THE ENTER KEY TRANSmits A 5-BIT KEYCODE TO THE COMPUTER, WHICH THEN TAKES APPROPRIATE ACTION CORRESPONDING TO THE DATA PREVIOUSLY KEYED INTO AND DISPLAYED ON THE DSKY. IN THE FIRST CASE, THE DEPRESSION OF THE "PROCEED" KEY INSTEAD OF AN "ENTER" WOULD HAVE CAUSED THE SYMPTOMS AND RESULTS REPORTED. IN THE SECOND CASE, IF A VERB 46 WAS KEYED IN, ONLY ANOTHER VERB KEY DEPRESSION WOULD HAVE BLANKED THE DSKY WITHOUT ENTERING THE DATA. ANOTHER POSSIBILITY WOULD BE ENTRY OF A VERB WHICH CAUSES NO ACTION AT ALL OR AN ACTION WHICH IS UNDETECTABLE.</p> <p>NO HARDWARE OR SOFTWARE FAILURES THAT COULD HAVE CAUSED THESE CONDITIONS HAVE BEEN IDENTIFIED. PROCEDURAL ERRORS OF THE TYPE DISCUSSED COULD HAVE CAUSED THE FAILURE CONDITIONS. HOWEVER, THE CREW CONSIDERS IT UNLIKELY THAT SUCH ERRORS WERE MADE.</p>		
ORGANIZATION: 5-2490 REFERENCES: MSC 30-DAY ANOMALY REPORT P-8 MSC 60-DAY REPORT, PA-R-69-2, P. 17-11	RESOLUTION: CLOSED DATE: 6-13-69 REV:		55

ANOMALY REPORT

NO. 2.1.1.20	TITLE: DAMAGE TO MAIN PARACHUTES	MISSION: APOLLO 9 EVENT TIME: 240:55
SYSTEM: CM	EARTH LANDING SUBSYSTEM (ELS)	
SUBSYSTEM:	<p>PROBLEM: DAMAGE TO THE MAIN PARACHUTES WAS REPORTED AT THE CREW DEBRIEFING, AND THE DAMAGE WAS SHOWN IN THE MOTION PICTURES TAKEN FROM THE CM. THE +Y CHUTE HAD A 20-INCH TEAR ALONG THE SEAM ON GORE NO. 34. ON THE +Z CHUTE, SHROUD LINE NO. 49 WAS BROKEN AND GORES NO. 1, 4, AND 65 HAD TEARS AND HOLES. THIS DAMAGE OCCURRED BEFORE THE RCS PROPELLANT DUMP. NR BELIEVES THE DAMAGE MAY HAVE RESULTED FROM A COLLISION OF THE TWO CHUTES CAUSED BY A 20-FOOT LAG IN DEPLOYMENT OF ONE OF THEM.</p>	
ACTION:	<p>THE MSC STRUCTURES/MECHANICS DIVISION ASSESSED THE DAMAGE AS SLIGHT AND RECOMMENDED NO CHANGES FOR APOLLO 10.</p>	
ORGANIZATION: 5-2490	"APOLLO 9 MISSION REPORT"	RESOLUTION: CLOSED
REFERENCES:	MSC-PA-R-69-2 PAGE 8-2, 3	DATE: 6-13-69 REV:
		56

ANOMALY REPORT

NO. 2.1.1.21	TITLE: DOCKING RING SEPARATION CHARGE HOLDER
SYSTEM: CM	MISSION: APOLLO 9
SUBSYSTEM: DOCKING	EVENT TIME: DESCENT-RECOVERY
PROBLEM:	<p>ONE DOCKING RING SEPARATION CHARGE HOLDER WAS DEFORMED AND OUT OF ITS CHANNEL, EXTENDING SEVERAL INCHES BEYOND THE PERIPHERY OF THE EXTERNAL TUNNEL STRUCTURE. SUCH A CONFIGURATION MIGHT FOUL OR CUT THE NYLON RISER LINES DURING PARACHUTE DEPLOYMENT.</p> <p>THE CHARGE HOLDERS ARE TWO SEMICIRCULAR STEEL RINGS ATTACHED AT ONE END WITH THE OTHER END FREE. THEY NORMALLY REMAIN IN A CHANNEL ABOUT AN INCH DEEP ON TOP OF THE REMAINING TUNNEL STRUCTURE. DURING GROUND TESTS, THE FREE END OF THESE HOLDERS OCCASIONALLY CAME OUT OF THE CHANNEL BUT NEVER DEFORMED TO THE EXTENT EXPERIENCED ON APOLLO 9. IT IS NOT KNOWN WHETHER THE DEFORMATION OCCURRED DURING DESCENT OR DURING RECOVERY OPERATIONS.</p>
ACTION:	<p>A RETAINER SPRING DESIGN HAS DEMONSTRATED THAT DURING SEPARATION, IT WILL REMAIN THE CHARGE HOLDER WITHOUT THE LUNAR MODULE ATTACHED. THIS DESIGN WILL BE INCORPORATED ON SPACECRAFT 106.</p>
ORGANIZATION: 5-2490	RESOLUTION: CLOSED
REFERENCES: MSC 30-DAY ANOMALY REPORT P-9	DATE: 6-13-69
	REV:
	57

DETAIL SHEET

ANOMALY 2.1.21

TITLE: DOCKING RING SEPARATION CHARGE HOLDER

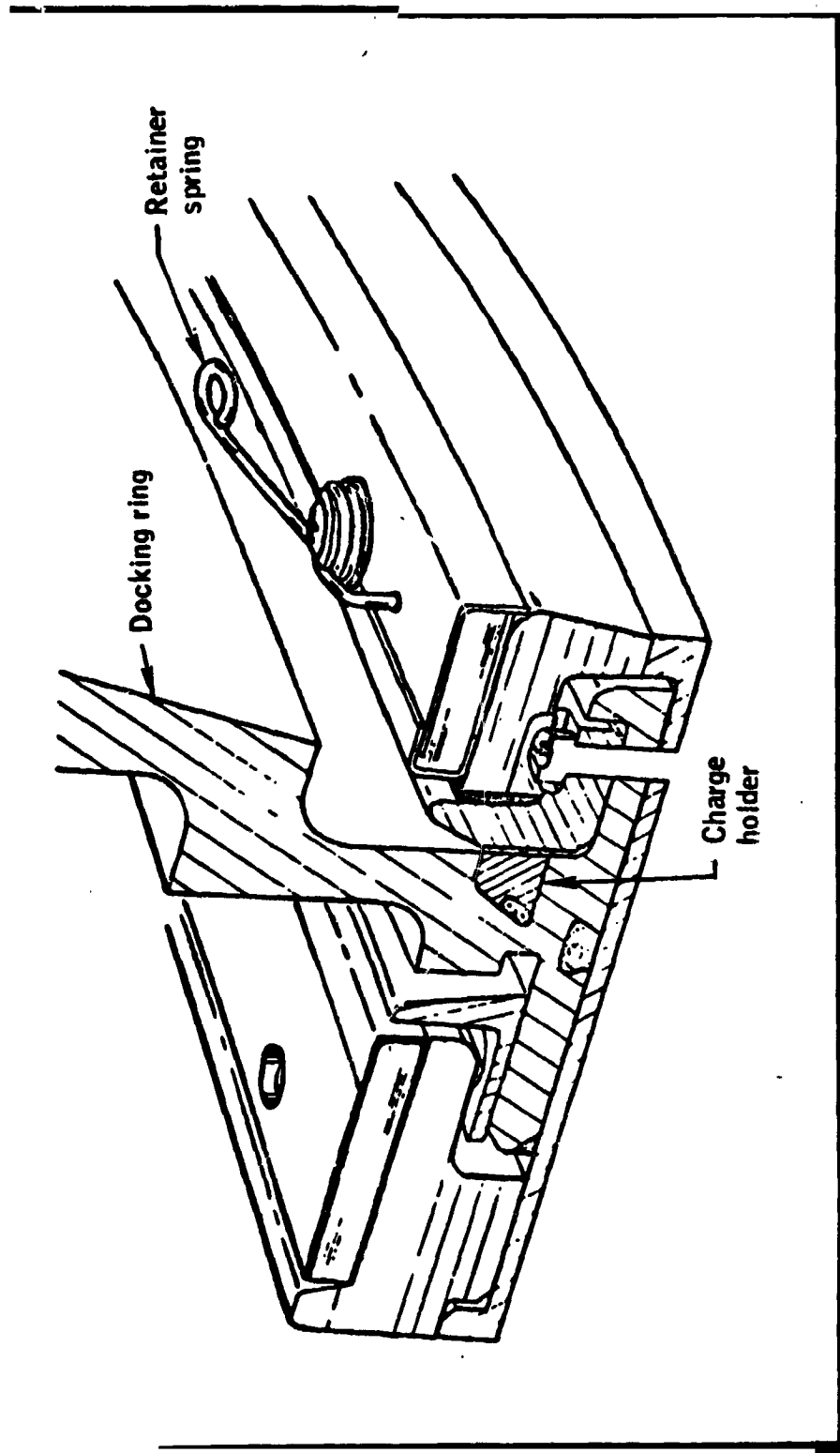


FIG. 2.1.21-1 DOCKING RING CHARGE HOLDER

ANOMALY REPORT

NO. 2.1.22	TITLE: DPS HELIUM REGULATOR MANIFOLD PRESSURE DROP
SYSTEM: LM	MISSION: APOLLO 9
SUBSYSTEM: DPS	EVENT TIME: 49:42
PROBLEM:	<p>SHORTLY AFTER THE FIRST DESCENT ENGINE IGNITION, THE CREW REPORTED AND TELEMETRY INDICATED A DECREASE IN SHE REGULATOR MANIFOLD PRESSURE. THIRTY SECONDS AFTER IGNITION, TELEMETRY INDICATED A PRESSURE OF 180 PSIA; 50 SECONDS AFTER IGNITION, PRESSURE STABILIZED AROUND 240 PSIA. CREW REPORTED PRESSURE STABILIZED. NOMINAL REGULATOR MANIFOLD PRESSURE IS 245 PSIA. ALL TEMPERATURE, PRESSURE, AND FLOW INDICATIONS SUBSTANTIATE A PLUGGED HEAT EXCHANGER IN THE SUPERCRITICAL HELIUM SYSTEM THE PLUGGING CLEARED DURING THE FIRING, AS INDICATED BY THE PRESSURE RISE IN THE SUPERCRITICAL HELIUM TANK AND THE RETURN TO NORMAL REGULATED PRESSURE.</p> <p>AFTER THE SUPERCRITICAL HELIUM SERVICING AT THE LAUNCH COMPLEX, THE TANK FILL AND VENT QUICK-DISCONNECTS ARE DRY BEFORE BEING CAPPED.</p>
ACTION:	<p>DURING THE LM-3 SERVICING, THE PRESSURE MUST HAVE DROPPED TO ZERO, ALLOWING AIR TO BE DRAWN INTO THE MANIFOLD BY CONDENSING OUT THE INCOMING AIR IN THE SUPERCRITICAL HELIUM TANK HEAT EXCHANGER. TESTS HAVE SHOWN THAT DROPPING THE MANIFOLD PRESSURE TO ZERO FOR ABOUT 30 MINUTES WILL ALLOW AIR TO BE "CRYO-PUMPED" INTO THE MANIFOLD TO THE TANK HEAT EXCHANGER, WHERE IT WILL FREEZE AND BLOCK THE HEAT EXCHANGER. THE FREEZING PROCESS TRANSFERS HEAT INTO THE SUPERCRITICAL HELIUM TANK, CAUSING A PRESSURE RISE OF ABOUT 90 PSI, VERY SIMILAR TO WHAT OCCURRED DURING THE LM-3 TOP-OFF. IF NO AIR WERE INTRODUCED, THE TANK PRESSURE WOULD BE EXPECTED TO RISE 10 PSI OR LESS.</p> <p>THE GROUND SUPPORT EQUIPMENT HAS BEEN MODIFIED FOR APOLLO 10 AND SUBSEQUENT MISSIONS TO ISOLATE THE PURGE SYSTEM FROM THE MANIFOLD PRESSURE CONTROL SYSTEM. ADDITIONAL EQUIPMENT MAY BE SUPPLIED TO PROVIDE THE CAPABILITY TO TEST FOR BLOCKAGE OF THE TANK HEAT EXCHANGER. NEW EQUIPMENT AND SERVICING PROCEDURES WILL BE SHIPPED TO THE LAUNCH SITE FOR APOLLO 10.</p>
ORGANIZATION: REFERENCES:	<p>5-2490 MSC 5-DAY REPORT, P. 14 MSC 30-DAY ANOMALY REPORT P-9</p> <p>RESOLUTION: CLOSED</p> <p>DATE: 6-13-69 REV:</p>

DETAIL SHEET

ANOMALY 2.1.1.22

TITLE: DESCENT PROPULSION REGULATOR MANIFOLD PRESSURE DROP

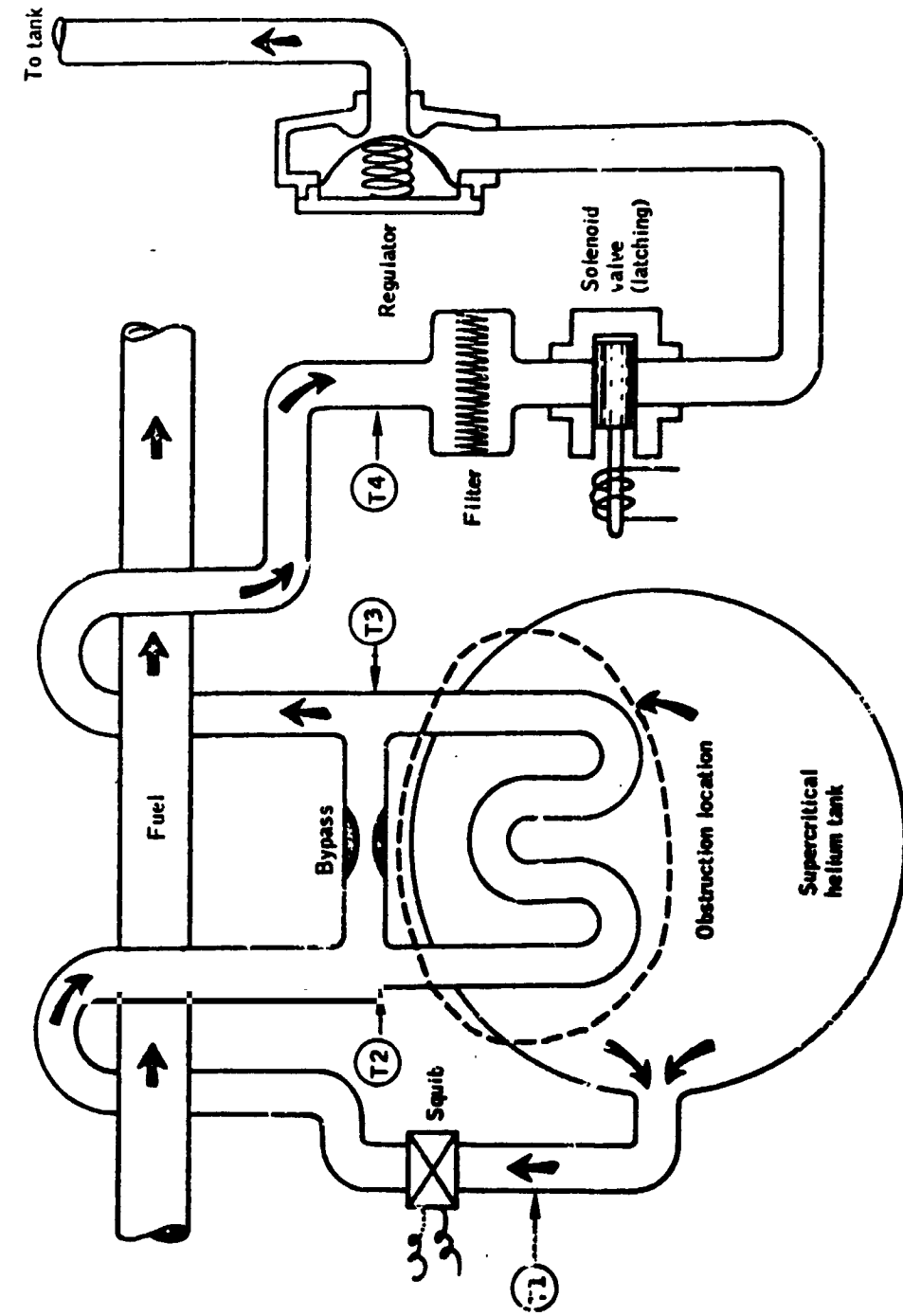


FIG. 2.1.1.22-1 DPS HELIUM REGULATOR

ANOMALY REPORT

NO. 2.1.1.23	TITLE: SUPERCRITICAL HELIUM PRESSURE DECAY
SYSTEM: LM	MISSION: APOLLO 9
SUBSYSTEM: DPS	EVENT TIME: 70:30
<p>PROBLEM: THE PRESSURE IN THE SUPERCRITICAL HELIUM TANK FOR THE DESCENT PROPULSION SYSTEM BEGAN DECAYING AT 2.9 PSI/HR IMMEDIATELY AFTER SHUTDOWN OF THE FIRST DESCENT ENGINE FIRING AND CONTINUED TO DECAY UNTIL STAGING. BECAUSE OF HEAT TRANSFER INTO THE TANK, THE PRESSURE SHOULD ALWAYS INCREASE UNDER NO-FLOW CONDITIONS. THE PRESSURE DECAY IS INDICATIVE OF A LEAK OF ABOUT 0.1 LB/HR FROM THE HELIUM SYSTEM.</p> <p>THE FLIGHT CONFIGURATION OF HELIUM TANK, SQUIB VALVE, BIMETALLIC FITTING, AND ASSOCIATED PLUMBING HAS NEVER BEEN TESTED TOGETHER FOR RESPONSE TO SQUIB VALVE FIRING SHOCK.</p>	
<p>ACTION: A TEST HAS BEEN MADE ON THE SQUIB VALVE ASSOCIATED PLUMBING HAVE ADEQUATE STRENGTH TO SURVIVE THE EXPECTED FLIGHT ENVIRONMENT FOR APOLLO 10 AND SUBSEQUENT. THE LEAK EXPERIENCED DURING APOLLO 9 WAS PROBABLY CAUSED BY A DEFECTIVE BRAZE THAT WAS INTERNAL TO THE SQUIB VALVE AND COULD NOT BE INSPECTED.</p>	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED
REFERENCES: MSC FIVE-DAY REPORT, P.13 MSC 30-DAY ANOMALY REPORT P-10	DATE: 6-13-69 REV:
61	

DETAIL SHEET

ANOMALY 2.1.1.23

TITLE: SUPERCRITICAL HELIUM PRESSURE DECAY

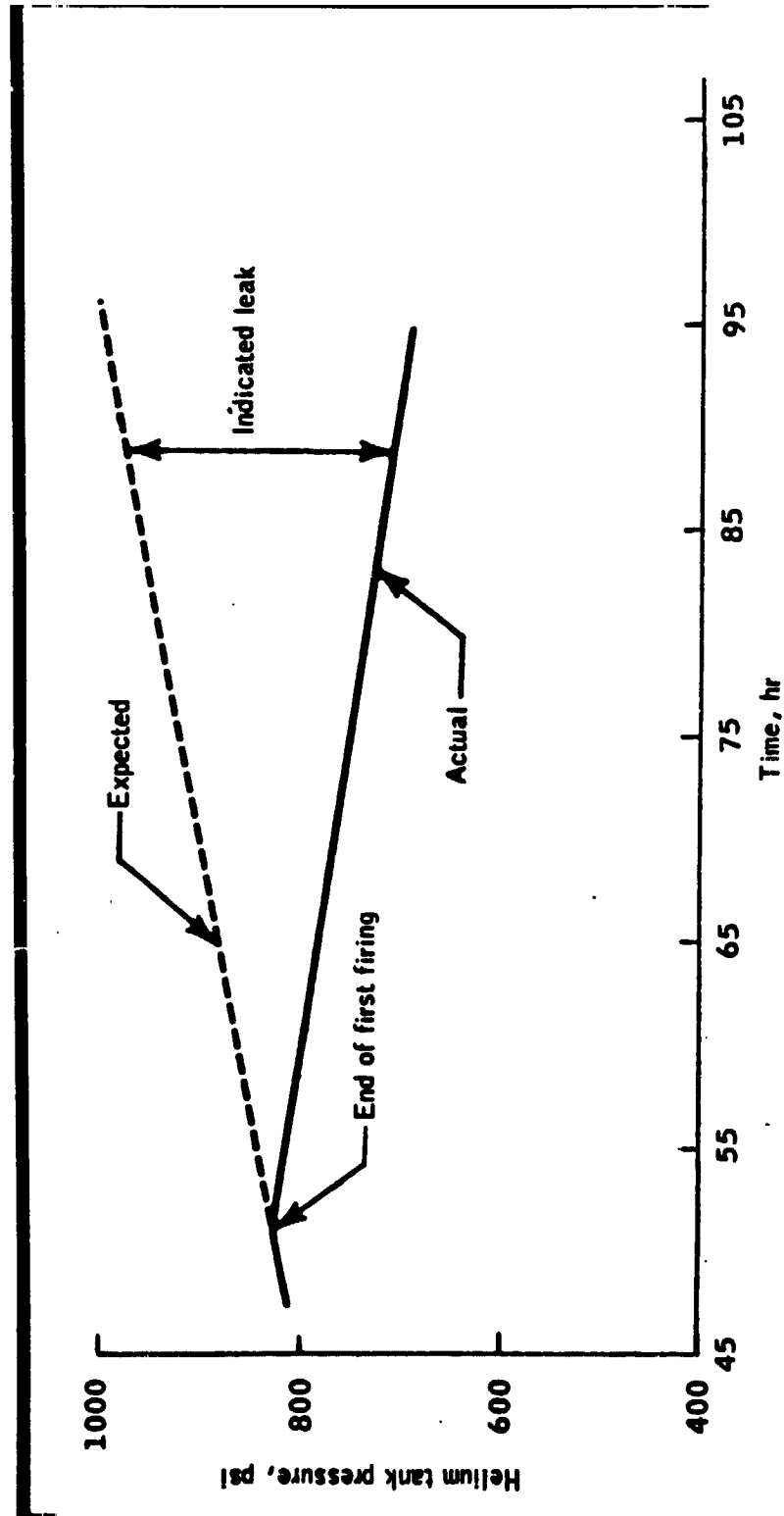


FIG. 2.1.23-1 SUPERCRITICAL HELIUM PRESSURE DECAY

DETAIL SHEET

ANOMALY 2.1.23

TITLE: SUPERCRITICAL HELIUM PRESSURE DECAY

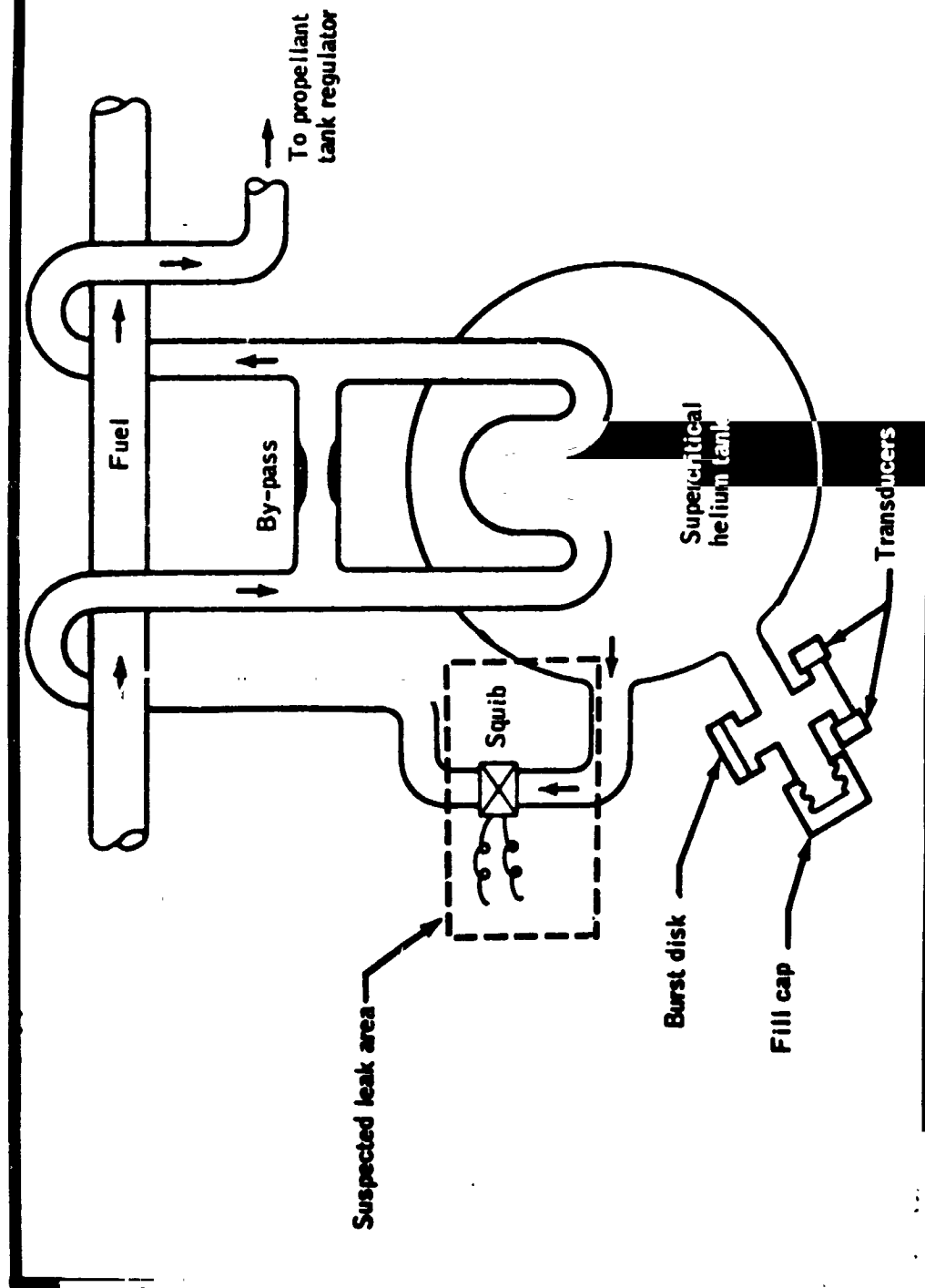


FIG. 2.1.23-2 SUPERCRITICAL HELIUM TANK

DETAIL SHEET

ANOMALY 2.1.23

TITLE: SUPERCRITICAL HELIUM PRESSURE DECAY

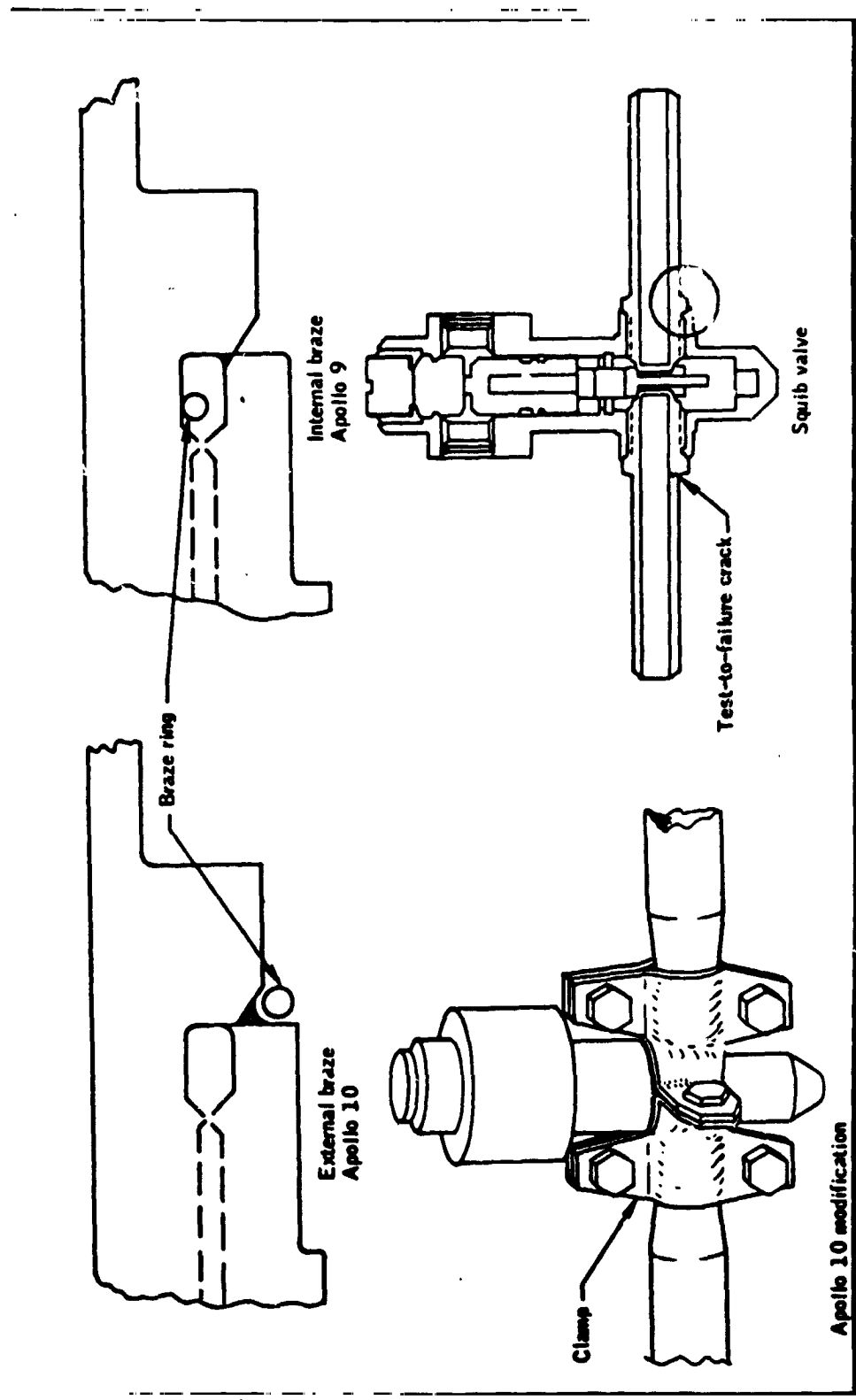


FIG. 2.1.23-3 SQUIB VALVE

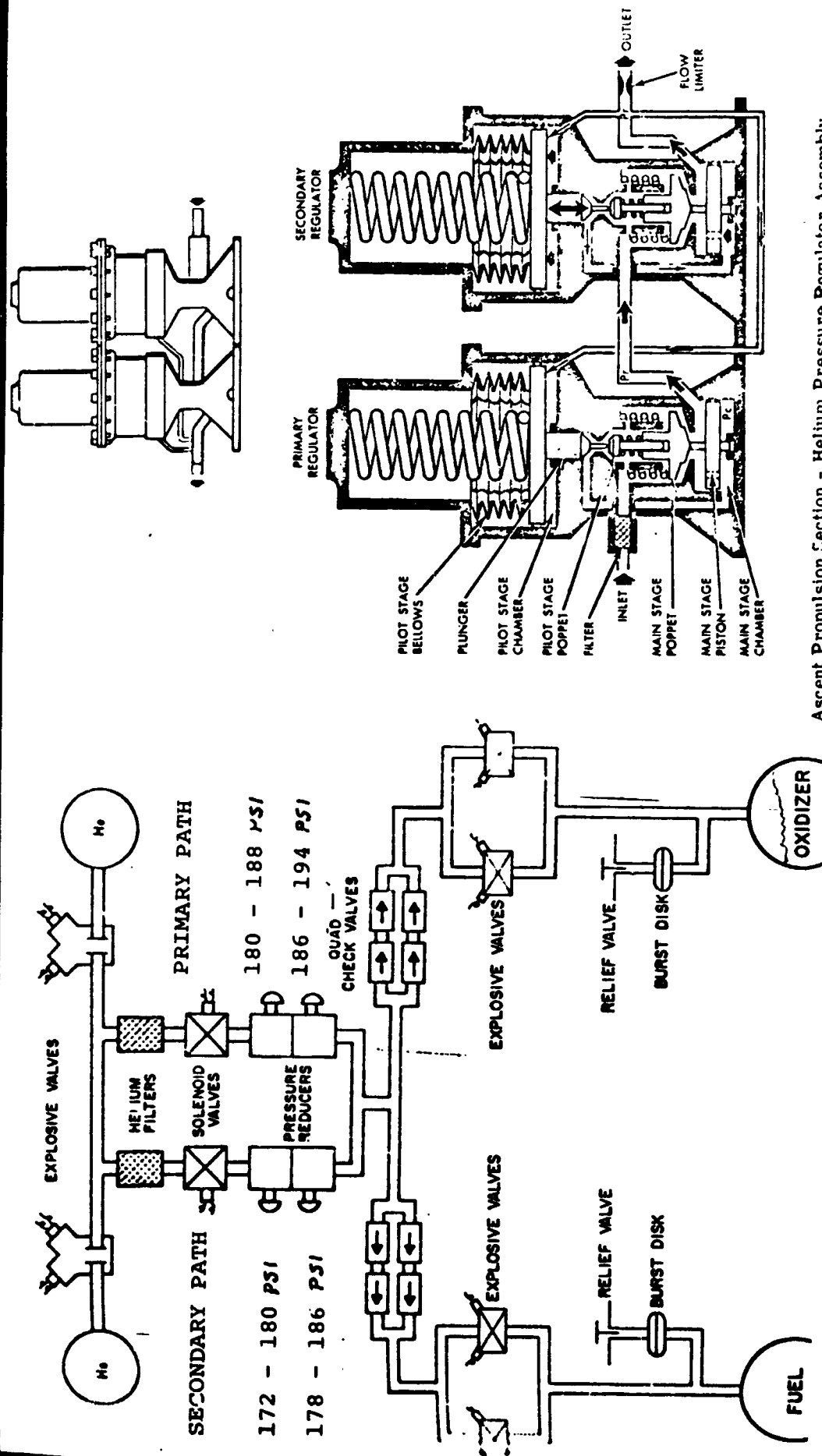
ANOMALY REPORT

NO. 2-1.24	TITLE: RCS THRUST CHAMBER PRESSURE SWITCH FAILED	MISSION: APOLLO 9
SYSTEM: LM		EVENT TIME: 48:08
SUBSYSTEM: RCS		
PROBLEM: AT 48:08 GET THE LM CREW REPORTED THAT THRUST CHAMBER PRESSURE SWITCH FAILED CLOSED ON RCS THRUSTER B4-UP. FAILED ON FIRST FIRING AND REMAINED IN THIS CONDITION UNTIL JUST PRIOR TO DOCKING, AFTER WHICH TIME IT REMAINED INTERMITTENT.		
ACTION: NONE ANTICIPATED AS MSC LISTS THIS ITEM AS INSIGNIFICANT.		
ORGANIZATION: 5-2490 REFERENCES: MSC 5-DAY REPORT, P. 12		RESOLUTION: CLOSED DATE: 6-13-69 REV:
		65

ANOMALY REPORT

NO. 2.1.25	TITLE: ASCE-2 PROPULSION SYSTEM REGULATOR LEG BLOCKAGE	MISSION: APOLLO 9 EVENT TIME: 102:00
SYSTEM: LM		
SUBSYSTEM: PROPULSION	<p>PROBLEM: THE APS HELIUM PROPELLANT TANKS PRESSURE DECAYED FROM 185 PSIA TO 177 PSIA IN THE FIRST 10 TO 15 SECONDS OF THE UNMANNED BURN TO DEPLETION, INDICATING THAT THE CLASS I REGULATOR LEG FAILED AND THE CLASS II REGULATOR LEG SUPPLIED PRESSURIZING HELIUM TO THE TANKS. AT 290 SECONDS INTO THE FIRING, THE HELIUM PRESSURE INCREASED TO APPROXIMATELY 177 PSIA AND REMAINED AT THAT LEVEL UNTIL OXIDIZER DEPLETION, INDICATING THAT THE PRIMARY REGULATOR IN THE CLASS II LEG FAILED OPEN AND THE SECONDARY REGULATOR REGULATED THE HELIUM PRESSURE TO THE PROPELLANT TANKS.</p>	
ACTION:	<p>AT THIS TIME, THE MOST LIKELY CONDITIONS WHICH COULD HAVE CAUSED THE INDICATED MALFUNCTION OF THE CLASS I REGULATOR (SEE FIGURE 17-30) WAS A FLOW PATH RESTRICTED BECAUSE OF CONTAMINATION IN THE FEEDBACK LINE FROM THE PILOT POPPET TO THE SLAVE PISTON. TESTS HAVE SHOWN THAT A REGULATOR BAND SHIFT CAN RESULT BY REDUCING THE ORIFICE SIZE AT THE POSSIBLE RESTRICTION POINT SHOWN ON THE FIGURE. A REDUCTION FROM 0.062 INCH TO 0.016 INCH WILL REDUCE THE REGULATED PRESSURE TO 177 PSIA.</p> <p>THE LIKELIHOOD THAT CONTAMINATION CAUSED THE INDICATION IS INCREASED BY THE FACT THAT THE SOLENOID VALVE WAS REPLACED AT THE LAUNCH SITE. NORMAL PROCEDURES REQUIRE BACKFLOWING THROUGH THE REGULATORS DURING THE REPLACEMENT PROCESS TO KEEP OUT CONTAMINATION. THE EXTERNAL GAS SOURCE IS FILTERED; HOWEVER, THERE IS NO FILTER IN THE FLIGHT SYSTEM TO PREVENT DAMAGE TO THE REGULATORS. CONTAMINATION OF A REGULATOR HAS OCCURRED AS A RESULT OF THIS PROCEDURE IN AT LEAST ONE PRIOR INSTANCE IN THE APOLLO PROGRAM.</p> <p>FINAL ASSESSMENT OF THIS ANOMALY AWAITS A DETAILED REVIEW & ANALYSIS OF RECENT WHITE SANDS TESTS & MSC COMPONENT TESTS.</p>	
ORGANIZATION: 5-2490 REFERENCES: MSC 5-DAY REPORT, P. 14 MSC 30-DAY ANOMALY REPORT P-15	RESOLUTION: OPEN	DATE: 6-13-69 REV:
66		

TITLE: ASCENT PROPULSION SYSTEM REGULATOR LEG BLOCKAGE



Ascent Propulsion Section - Helium Pressure Regulator Assembly

FIG. 2.1.25-1 APS REGULATOR DIAGRAM

ANOMALY REPORT

NO. . 2.1.26	TITLE: ROUGH DESCENT ENGINE THROTTLING
SYSTEM: LM	MISSION: APOLLO 9
SUBSYSTEM: DPS	EVENT TIME: 93:47
PROBLEM:	<p>DURING THE SECOND DESCENT ENGINE FIRING, THE ENGINE WAS ROUGH AT ABOUT 27 PERCENT THROTTLE FOR A FEW SECONDS, THEN SETTLED OUT AND OPERATED SMOOTHLY DURING THE REMAINDER OF THE FIRING. THE DATA DURING THE ROUGH PERIOD SHOWED A RISE IN THE OXIDIZER INTERFACE PRESSURE, FOLLOWED BY A RISE IN THE FUEL INTERFACE PRESSURE, AND BOTH SUBSEQUENTLY RETURNING TO THE NORMAL PRESSURE. DURING THIS TIME PERIOD, THE ENGINE CHAMBER PRESSURE FLUCTUATED, CAUSING THE ROUGHNESS.</p> <p>TESTS HAVE SHOWN THAT WITH HELIUM DELIBERATELY INTRODUCED INTO THE LINE, THE INTERFACE PRESSURES INCREASE AS THE GAS PASSES THE THROTTLE ASSEMBLY. THE THROTTLED AREA OPERATES AT CAVITATING PRESSURES, GIVING RISE TO A PRESSURE INCREASE AS THE HELIUM PASSES THROUGH THE AREA. THE VARIATION OF INTERFACE PRESSURES AND THE BLEEDING OF HELIUM INTO THE INJECTOR RESULT IN FLUCTUATION IN THE ENGINE CHAMBER PRESSURE. THESE TEST RESULTS MATCH VERY CLOSELY THE FLIGHT DATA DURING THE ENGINE ROUGHNESS.</p>
ACTION:	<p>THE HELIUM IN THE PROPELLANT TANKS COULD ENTER THE PROPELLANT LINES UNDER CERTAIN CONDITIONS OF ACCELERATION. HOWEVER, A "ZERO-G" CUP OVER THE LINES INSIDE THE PROPELLANT TANK GREATLY REDUCES THE LIKELIHOOD OF HELIUM GETTING INTO THE FEED LINES.</p> <p>IN ANY EVENT, TESTS HAVE DEMONSTRATED THAT INGESTION OF HELIUM INTO THE ENGINE IN THIS MANNER HAS NO DETRIMENTAL EFFECT ON THE SYSTEM. HOWEVER, IF HELIUM SHOULD GET INTO THE LINE, THE ENGINE MAY FIRE ROUGHLY SOMETIME DURING THE FIRST SEVERAL SECONDS OF A FIRING.</p>
ORGANIZATION: 5-2490	RESOLUTION: CLOSED
REFERENCES: MSC 30-DAY ANOMALY REPORT P-16	DATE: 6-13-69
	REV:
	68

ANOMALY REPORT

NO. 2.1.1.27	TITLE: OSCILLATIONS IN PITCH DURING APS BURN	MISSION: APOLLO 9
SYSTEM: LM-APS		EVENT TIME: 101:53
SUBSYSTEM: APS		
PROBLEM:	<p>A 5° PER SECOND PITCH RATE OSCILLATION WAS REPORTED DURING THE APS UNMANNED BURN TO DEPLETION.</p> <p>THE APS BURN TO DEPLETION WAS PERFORMED WITH ATTITUDE CONTROL IN THE PNGCS AUTOMATIC MODE. IN THIS MODE ATTITUDE ERROR DEADBAND IS + 0.3 DEGREES AND RATE DEADBAND IS + 1.4 DEGREES PER SECOND.</p> <p>A DISTURBING TORQUE CAN BE EXPECTED DUE TO THRUST VECTOR MISALIGNMENT WITH THE VEHICLE CENTER OF GRAVITY. THE DISTURBING TORQUE IS REACTED WITH AN OPPOSING TORQUE FROM THE RCS JETS. IF THE RCS JET TORQUE IS GREATER THAN THE DISTURBING TORQUE THE RATE WILL NOT EXCEED 1.4 DEGREES PER SECOND, AND IF LESS, THE VEHICLE WILL TUMBLE.</p>	
ACTION:	<p>MSC IS NOT CARRYING THIS ITEM AS AN OPEN ANOMALY AT THIS TIME. NO ACTION IS ANTICIPATED.</p>	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES:		REV:
		69

ANOMALY REPORT

NO. 2-1-28	TITLE:	NO ONBOARD INDICATION OF LM DPS SUPERCRITICAL HELIUM PRESSURE
SYSTEM: LM	MISSION:	APOLLO 9
SUBSYSTEM: INSTRUMENTATION	EVENT TIME:	44:15
<p>PROBLEM: LUNAR MODULE PILOT (LMP) REPORTED THE SUPERCRITICAL HELIUM PRESSURE READING WAS ZERO. GROUND TELEMETRY READS OK AT 686 PSI. THE CREW DISPLAY IS OBTAINED FROM PRESSURE TRANSDUCER GQ3436P ONLY AND GROUND TELEMETRY DATA IS AVAILABLE VIA TRANSDUCER TP3435P AND GF3436P (SEE SCHEMATIC, ATTACHED). THE CREW DISPLAY WAS NOTED TO BE FUNCTIONING CORRECTLY AT APPROXIMATELY 47:00 GET AND WAS INTERMITTENT AGAIN AT 90:50.</p> <p>ACTION: NONE ANTICIPATED AS FLIGHT TROUBLESHOOTING COULD NOT ISOLATE THE PROBLEM. DESIGN IMPROVEMENTS HAVE BEEN MADE TO THE VEHICLE PRESSURE TRANSDUCERS EFFECTIVE FOR LM-8 AND SUBS TO RESOLVE A HIGH REJECTION RATE IN ACCEPTANCE TESTING. THE DESIGN CHANGES MADE RESOLVE SEVERAL PROBLEM AREAS BUT INTERMITTENT OUTPUT HAS NOT BEEN A SPECIFIC CAUSE FOR REDESIGN. THE REDESIGNED TRANSDUCERS ARE UTILIZED FOR CRITICAL MEASUREMENTS ONLY WHICH DOES <u>NOT</u> INCLUDE THE SUPERCRITICAL HELIUM PRESSURE.</p>		
ORGANIZATION: 5-2490	RESOLUTION:	CLOSED
REFERENCES: MSC 5-DAY REPORT, P. 11	DATE:	6-13-69
	REV:	
		70

DETAIL SHEET

ANOMALY 2.1.28

TITLE: SUPERCRITICAL HELIUM PRESSURE INSTRUMENTATION

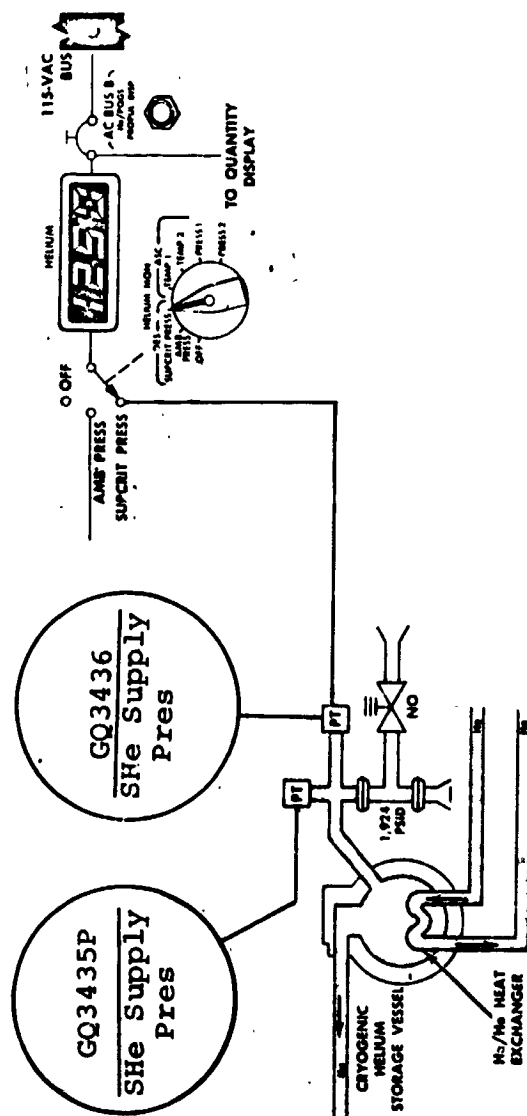


FIG. 2.1.28-1 SUPERCRITICAL HELIUM PRESSURE INSTRUMENTATION

ANOMALY REPORT

NO. 2.1.29	TITLE: OXYGEN PURGE SYSTEM LIGHT	MISSION: APOLLO 9
SYSTEM: CM		EVENT TIME: 89:00
SUBSYSTEM: LIFE SUPPORT		
PROBLEM:	THE CHECKOUT LIGHT ON THE COMMANDER'S OXYGEN PURGE SYSTEM DID NOT COME ON DURING PREPARATION FOR RENDEZVOUS. IT HAD BEEN ERRATIC EARLIER IN THE FLIGHT.	
ACTION:	AN EXAMINATION OF ALL POSSIBLE CONDITIONS WHICH COULD HAVE CAUSED THE CHECKOUT LIGHT TO FALL INDICATE THAT THE MAIN POWER SWITCH ACTUATOR MECHANISM DID NOT CLOSE THE SWITCH. CHANGES INCORPORATED INTO THE ACTUATOR MECHANISM FOR APOLLO 10 AND SUBSEQUENT ARE: <ol style="list-style-type: none">1. CHANGE TYPE OF TEFLON INSERT MATERIAL IN THE FLEXIBLE CABLE.2. CHANGE TO A SWIVEL JOINT IN THE FLEXIBLE CABLE AT THE OXYGEN PURGE SYSTEM INTERFACE.3. INCREASE CAM RISE ON SWITCH ACTUATOR CAM.4. BOND SWITCH ACTUATOR CAM TO SLIDE.5. BOND SWITCH IN PLACE AFTER ADJUSTMENT.	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: FINAL FLIGHT REPORT, 3-13-69 MSC 30-DAY ANOMALY REPORT, P-18		REV:
		72

ANOMALY REPORT

NO. 2.1.30	TITLE: DESCENT FUEL TANK TEMPERATURE SHIFTS	MISSION: APOLLO 9
SYSTEM: LM		EVENT TIME:
SUBSYSTEM: PROPULSION		
PROBLEM:	DESCENT FUEL TANK TEMPERATURES (GQ3718 AND GQ3719) INDICATED RANDOM POSITIVE SHIFTS OF 4 TO 5°F. BECAUSE OF LARGE THERMAL MASS OF PROPELLANT TANKS SUDDEN TEMPERATURE CHANGES INDICATED COULD NOT HAVE OCCURRED.	
ACTION:	GAEC ADVISED OF ANOMALY BY MSC TWX.	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC FIVE-DAY REPORT, P. 11		REV:
		73

ANOMALY REPORT

NO. 2.1.1.31	TITLE: LM VALVE POSITION INDICATOR ON LMP SUIT ISOLATION VALVE IS INOPERATIVE	MISSION: APOLLO 9
SYSTEM: LM		EVENT TIME: 75:00
SUBSYSTEM: ECS		
PROBLEM:	GROUND TELEMETRY INDICATED THE LUNAR MODULE PILOT'S (LMP) SUIT ISOLATION VALVE WAS IN THE "SUIT DISCONNECT" POSITION. THE LMP CONFIRMED THAT THE SUIT ISOLATION VALVE WAS IN THE "SUIT FLOW" POSITION.	
ACTION:	NONE ANTICIPATED AS MSC DOES NOT LIST THIS AS A FLIGHT ANOMALY.	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 5-DAY REPORT, PG. 11		REV:
		74

ANOMALY REPORT

NO. 2.1.1.32	TITLE: ABORT GUIDANCE SYSTEM (AGS) CAUTION AND WARNING LIGHT ON	MISSION: APOLLO 9
SYSTEM: LM		EVENT TIME: 89:43
SUBSYSTEM: INSTRUMENTATION		
PROBLEM:	<p>AN ABORT GUIDANCE SYSTEM (AGS) WARNING ALARM OCCURRED DURING THE SECOND POWER-UP SEQUENCE. THE AGS CHECKED OUT SATISFACTORILY.</p> <p>THE ALARM IS NORMALLY CAUSED BY EITHER A SELF-TEST FAILURE OR BY AN OUT-OF-LIMITS CONDITION. THE SPECIFICATION LIMITS FOR ALARMS AND THE OPERATING SPECIFICATION LIMITS OF THE PARAMETERS HAVE SUFFICIENT SPREAD THAT AN OUT-OF-SPECIFICATION CONDITION WOULD HAVE CAUSED A MALFUNCTION OF THE ABORT GUIDANCE SYSTEM.</p>	
ACTION:	<p>THE MOST LIKELY CAUSE OF THE ANOMALY WAS EITHER A SHORTED OR BROKEN WIRE BETWEEN THE ABORT ELECTRONICS ASSEMBLY AND THE SIGNAL CONDITIONING ELECTRONICS ASSEMBLY (26 GAGE WIRES WITH SEVEN SPLICES), A FAILURE WITHIN A SIGNAL CONDITIONING ELECTRONICS ASSEMBLY, OR A FAILURE IN THE CAUTION AND WARNING SYSTEM.</p> <p>THE FIVE ABORT GUIDANCE WARNING PARAMETERS IN LM-4 WERE MEASURED AND VERIFIED TO BE WITHIN SPECIFICATION LIMITS, WITH SUFFICIENT SEPARATION BETWEEN THE OPERATING LIMITS AND THE CAUTION AND WARNING LIMITS.</p>	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 30-DAY ANOMALY REPORT, P-12		REV:
		75

DETAIL SHEET

ANOMALY 2.1.1.32

TITLE: ABORT GUIDANCE SYSTEM (AGS) CAUTION AND WARNING LIGHT ON

BACKGROUND:

THE CAUTION AND WARNING ELECTRONICS PROVIDES THE WARNING IF ANY ONE OF THE FOLLOWING CONDITIONS IS PRESENT:

1. THE 12-V DC POWER SUPPLY VOLTAGE IS OUT OF LIMITS.
2. THE 28-V DC POWER SUPPLY VOLTAGE IS OUT OF LIMITS.
3. THE AC POWER SUPPLY FREQUENCY IS OUT OF LIMITS.
4. THE ABORT ELECTRONICS FAILS A SELF-TEST.
5. AN OVERTEMPERATURE SWITCH OPENS IN THE ABORT ELECTRONICS.

SUBSEQUENTLY, AT APPROXIMATELY 91:45:00, THE ABORT GUIDANCE WAS INITIALIZED AND CALIBRATED SATISFACTORILY. AN INSTRUMENTATION ANOMALY IS, THEREFORE, SUSPECTED BECAUSE THE ALARM LIMITS ON THE FIVE PARAMETERS ARE SO BROAD THAT A PERFORMANCE DEGRADATION WOULD HAVE BEEN DETECTED IF ANY ONE OF THE FIVE HAD BEEN OUT OF LIMITS. THE CREW PERFORMED A CHECK CONSISTING OF POWERING DOWN THE ABORT GUIDANCE, CYCLING THE CAUTION AND WARNING CIRCUIT BREAKER, AND POWERING UP THE ABORT GUIDANCE. THE SAME WARNING APPEARED, THUS VERIFYING THAT THE CAUTION AND WARNING OUTPUT RELAY WAS NOT THE PROBLEM. ADDITIONALLY, OTHER MEASUREMENTS PASSING THROUGH THE SAME SIGNAL CONDITIONER SUBASSEMBLY AS THESE ABORT GUIDANCE PARAMETERS WERE READING PROPERLY; THEREFORE, NO SIGNAL CONDITIONER ELECTRONICS POWER SUPPLY FAILURES WERE INDICATED. THE MOST LIKELY CAUSE OF THE ANOMALY, THEN, WAS A SHORTED OR BROKEN WIRE BETWEEN THE ABORT GUIDANCE AND THE SIGNAL CONDITIONER INPUTS, A FAILURE WITHIN A SIGNAL CONDITIONER ELECTRONICS CIRCUIT, OR A FAILURE WITHIN A CAUTION AND WARNING CIRCUIT. SINCE NONE OF THE ABORT GUIDANCE PARAMETERS ARE TELEMETERED OR DISPLAYED, NO DEFINITE FAILURE ISOLATION CAN BE ACHIEVED AT THIS TIME.

ANOMALY REPORT

NO. 2.1.1.33	TITLE: PUSH-TO-TALK SWITCHES INOPERATIVE
SYSTEM: LM	MISSION: APOLLO 9
SUBSYSTEM: COMMUNICATIONS	EVENT TIME: 88:55:00
PROBLEM:	<p>THE LUNAR MODULE PILOT'S PUSH-TO-TALK SWITCHES, LOCATED ON THE UMBILICAL AND ON THE ATTITUDE CONTROLLER, WERE INOPERATIVE AT ABOUT 89 HOURS. THE LUNAR MODULE PILOT USED THE VOX MODE FOR TRANSMITTING FOR THE REMAINDER OF LUNAR MODULE OPERATIONS. FAILURE OF BOTH SWITCHES IS NOT PROBABLE. THE COMMON PATH ON EITHER SIDE OF THE SWITCHES INCLUDES SWITCH CONTACTS ON THE AUDIO SECTION, CONNECTORS, AND DIODES IN THE SIGNAL PROCESSOR ASSEMBLY. THE PROBLEM WAS PROBABLY CAUSED BY A DISCONTINUITY (BROKEN WIRE) IN THE COMMON WIRE TO THE PARALLEL PUSH-TO-TALK SWITCHES.</p> <p>THE PUSH-TO-TALK MODE OF COMMUNICATION IS ISOLATED FROM THE VOX MODE OF COMMUNICATION. IN ADDITION, SWITCHING THE BACKUP PUSH-TO-TALK MODE WILL BYPASS MOST OF THE COMMON WIRING WHERE THE FAILURE MAY HAVE OCCURRED.</p>
ACTION:	<p>THE OPERATING PROCEDURES HAVE BEEN CHANGED TO INCLUDE MALFUNCTION TROUBLESHOOTING PROCEDURES THAT CAN BE USED TO CIRCUMVENT THIS TYPE PROBLEM.</p>
ORGANIZATION: 5-2490	RESOLUTION: CLOSED
REFERENCES: FINAL FLIGHT REPORT, 3-13-69 MSC 30-DAY ANOMALY REPORT P-11	DATE: 6-13-69 REV:

ANOMALY 2.1.33

TITLE: PUSH-TO-TALK SWITCHES INOPERATIVE

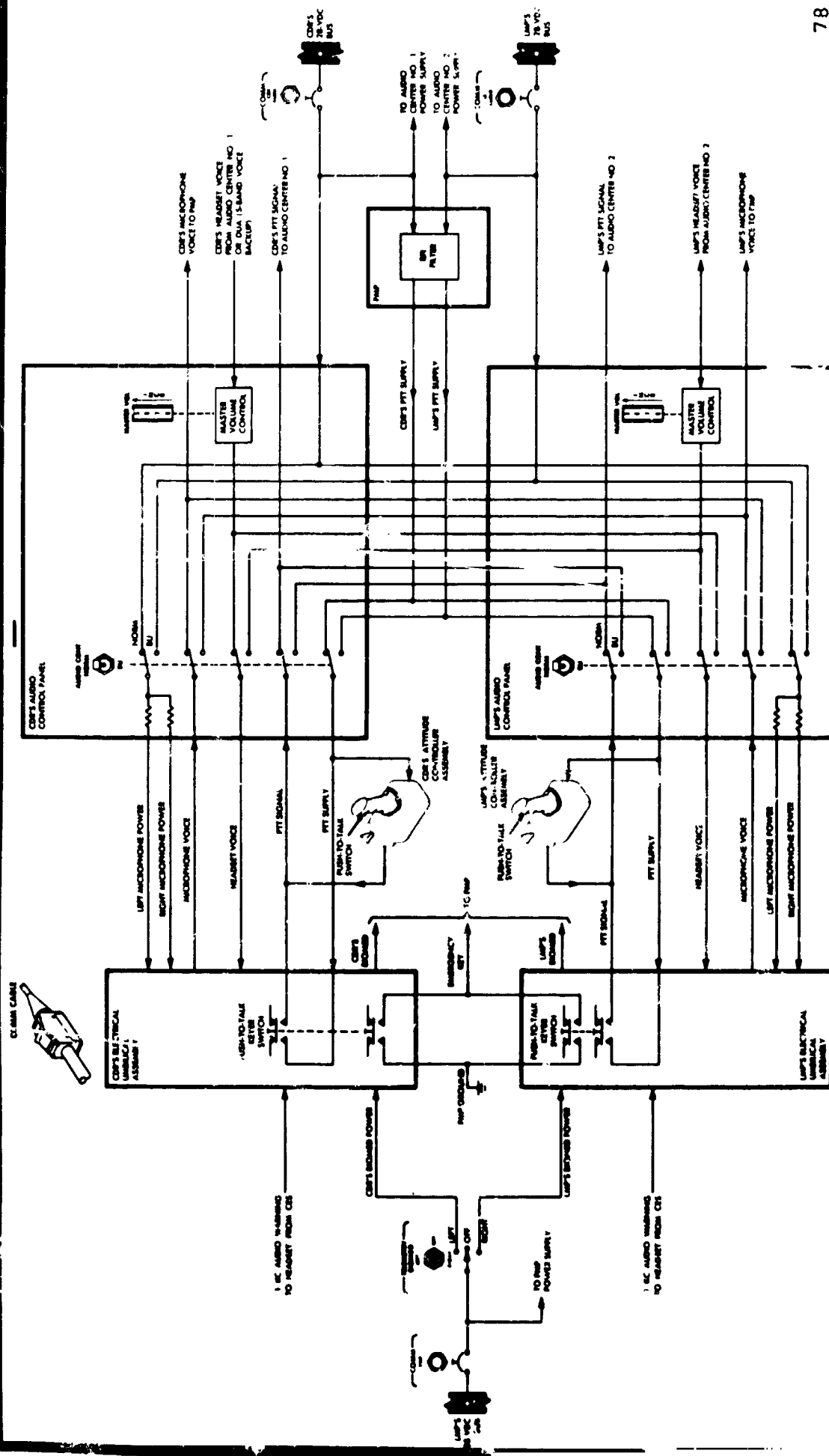


FIG. 2.1.33-1 **PUSH-TO-TALK SWITCH DIAGRAM**

ANOMALY REPORT

NO. 2.1.34	TITLE: TRACKING LIGHT FAILURE	
SYSTEM: LM	MISSION: APOLLO 9	
SUBSYSTEM: DISPLAYS AND CONTROL; CREW PROVISIONS	EVENT TIME: 96:33	
PROBLEM:	<p>DURING THE RENDEZVOUS MANEUVERS, THE CM PILOT MAINTAINED VISUAL CONTACT OF THE LM BY OBSERVING THE TRACKING LIGHT. AFTER LM STAGING, BUT PRIOR TO THE CDH BURN, THE CMP REPORTED LOSS OF VISUAL CONTACT. THE CDR IN THE LM ALSO REPORTED LOSS OF REFLECTED FLASHING FROM THE TRACKING LIGHT. THE TRACKING LIGHT WAS REPORTED INOPERATIVE THROUGHOUT THE REMAINDER OF THE LM MISSION. IT HAS ALSO BEEN REPORTED THAT POWER CONSUMPTION BY THE TRACKING LIGHT CIRCUIT WOULD INDICATE A SHORT IN THE HIGH VOLTAGE CIRCUITS. BASED ON FAILURE HISTORY, BREAKDOWN IN THE PULSE-FORMING NETWORK IS CONSIDERED THE MOST LIKELY CAUSE OF THE FAILURE.</p>	
ACTION:	<p>TESTS HAVE BEEN COMPLETED WHICH SHOW THAT THE APOLLO 10 TRACKING LIGHT CONFIGURATION CAN WITHSTAND THE VIBRATION, SHOCK, VACUUM, AND THERMAL STRESS OF THE MISSION. THIS CONFIGURATION DIFFERS FROM THE APOLLO 9 IN THAT IT CONTAINS AN ARC-SUPPRESSING CAPACITOR AND HAD SUCCESSFULLY COMPLETED A THERMAL VACUUM ACCEPTANCE TEST. A MODIFIED TRACKING LIGHT WITH INCREASED RELIABILITY WILL BE AVAILABLE FOR APOLLO 11. THE APOLLO 11 UNIT HAS A PULSE-FORMING NETWORK AND FLASH HEAD THAT HAVE BEEN MODIFIED TO ELIMINATE VOLTAGE BREAKDOWN IN THE FLIGHT ENVIRONMENT.</p>	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 5-DAY REPORT, P. 12		REV:
MSC 30-DAY ANOMALY REPORT P-11		

DETAIL SHEET

ANOMALY 2.1.34

TITLE: TRACKING LIGHT FAILURE

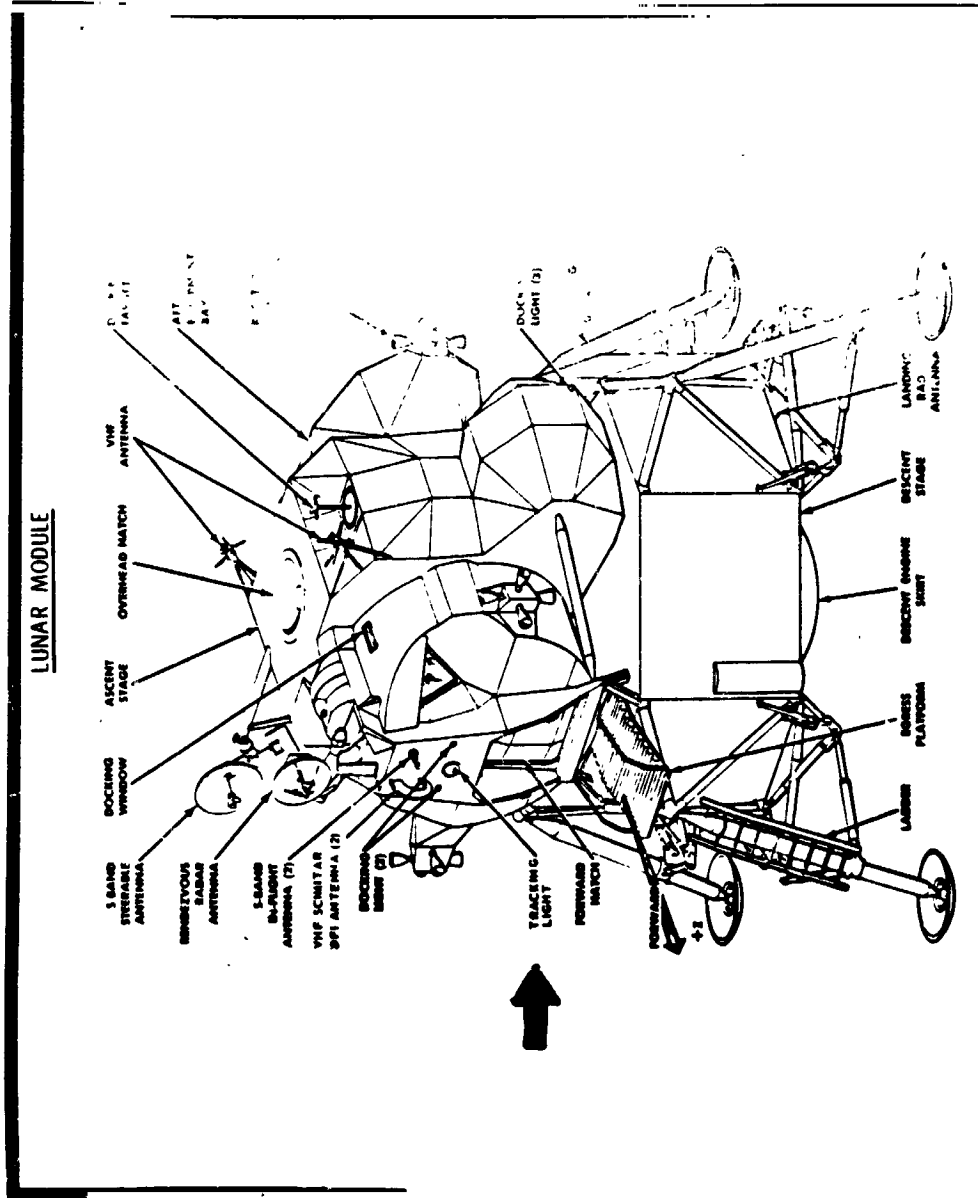


FIG. 2.1.34-1 LUNAR MODULE

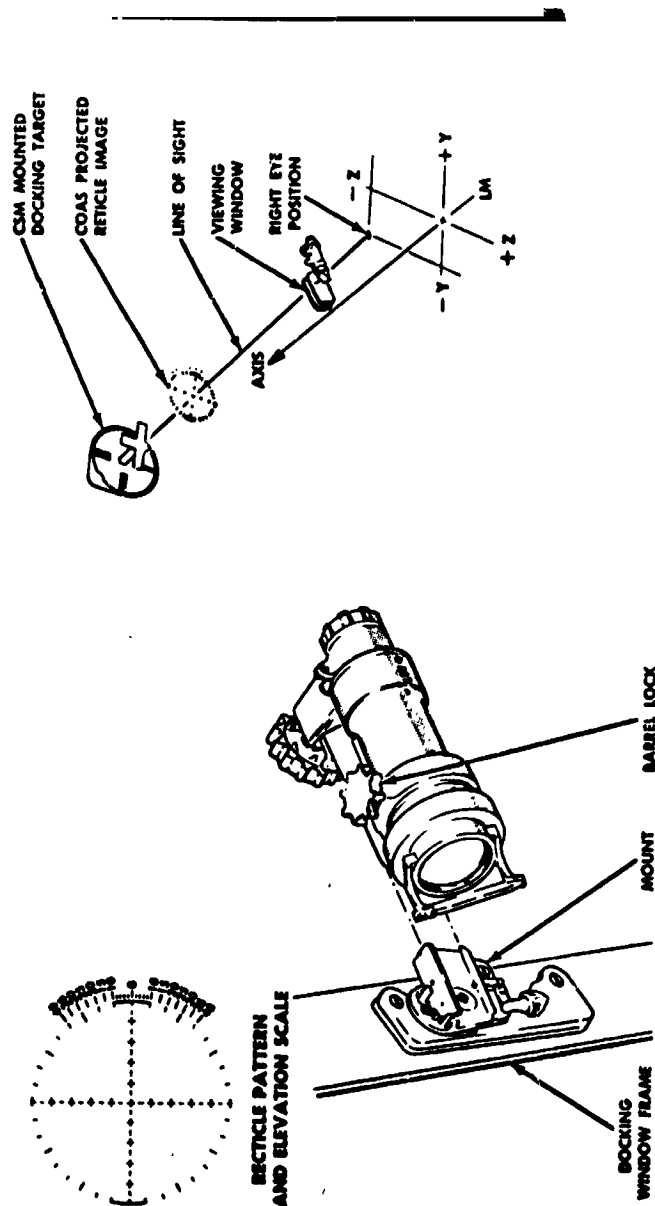
ANOMALY REPORT

NO. 2.1.35	TITLE: LIGHTING FOR CREW OPTICAL ALIGNMENT SIGHT	
SYSTEM: LM	MISSION: APOLLO 9	
SUBSYSTEM: GNCS	EVENT TIME: 98:40	
PROBLEM:	<p>THE APOLLO 9 CREW COMMENTS INDICATED THAT BACKGROUND AND RETICLE BRIGHTNESS "WASHED OUT" THE COMMAND MODULE CREW OPTICAL ALIGNMENT SIGHT RETICLE IMAGE DURING RENDEZVOUS DOCKING. CONDITION BELIEVED TO HAVE BEEN CAUSED BY EITHER (a) THE SUN CAUSING DOCKING TARGET IN COMMAND MODULE WINDOW TO BE WASHED OUT, OR (b) THE SUN REFLECTED OFF THE DOCKING TARGET OR COMMAND MODULE WASHED OUT CREWMAN OPTICAL ALIGNMENT SIGHT RETICLE PATTERN. THE SUN WAS BEHIND AND TO THE LEFT OF LUNAR MODULE WINDOW AND DIRECTLY ON THE COMMAND MODULE DOCKING TARGET.</p>	
ACTION:	<p>TO OVERCOME THIS PROBLEM, THE LIGHT INTENSITY FILTER WHICH WAS HOUSED IN THE BARREL ASSEMBLY WILL BE REPLACED WITH A DIFFUSER LENS. A REMOVABLE/DETACHABLE FILTER ASSEMBLY WILL BE PROVIDED AS A SNAP-ON DEVICE TO THE FORWARD PORTION OF THE BARREL. BY REMOVING THE FILTER, THE BRIGHTNESS OF THE RETICLE PATTERN IS INCREASED TO ALLOW THE RETICLE PATTERN TO BE VISIBLE UPON A 10 TO 13 000 FOOT-LAMBERT GLARE BACKGROUND. WITH THE FILTER IN PLACE, THE REDUCED BRIGHTNESS WILL ALLOW STAR ACQUISITION. THIS CHANGE WILL BE IMPLEMENTED ON SPACECRAFT 106. IN ADDITION, A MORE POWERFUL LIGHT SOURCE IS BEING CONSIDERED FOR THE RETICLE PATTERN. A TEST WILL BE CONDUCTED TO DEMONSTRATE THE PERFORMANCE OF THIS CHANGE. SHOULD THE CHANGE NOT BE ADEQUATE, CONSIDERATION WILL BE GIVEN TO PROVIDING A MORE POWERFUL LIGHT SOURCE TO INCREASE THE ILLUMINATION OF THE RETICLE PATTERN.</p>	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: FINAL FLIGHT REPORT, 3-13-69		REV:
MSC 30-DAY ANOMALY REPORT P-18		81

DETAIL SHEET

ANOMALY 2.1.35

TITLE: LIGHTING FOR CREW OPTICAL ALIGNMENT SIGHT



OPTICAL ALIGNMENT SIGHT

FIG. 2.1.35-1

DETAIL SHEET

ANOMALY 2.1.35

TITLE: LIGHTING FOR CREW OPTICAL ALIGNMENT SIGHT

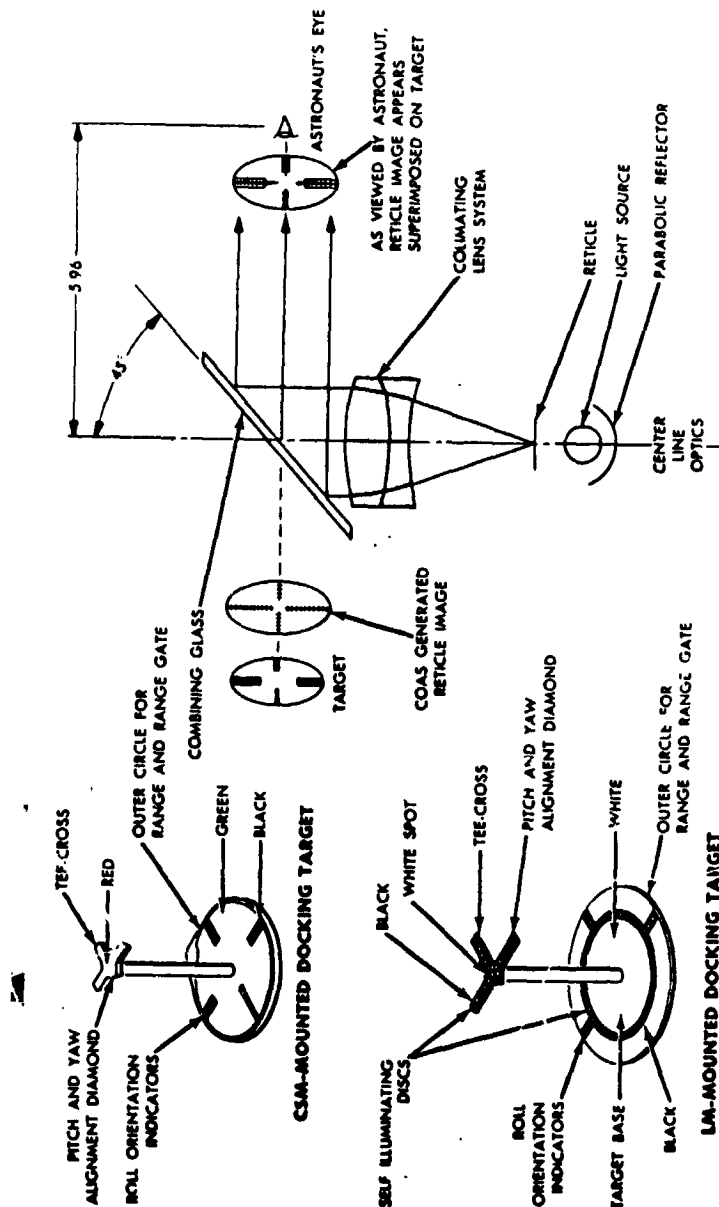


FIG. 2.1.35-2 OPTICAL PATH DETAILS

TITLE: LIGHTING FOR CREW OPTICAL ALIGNMENT SIGHT

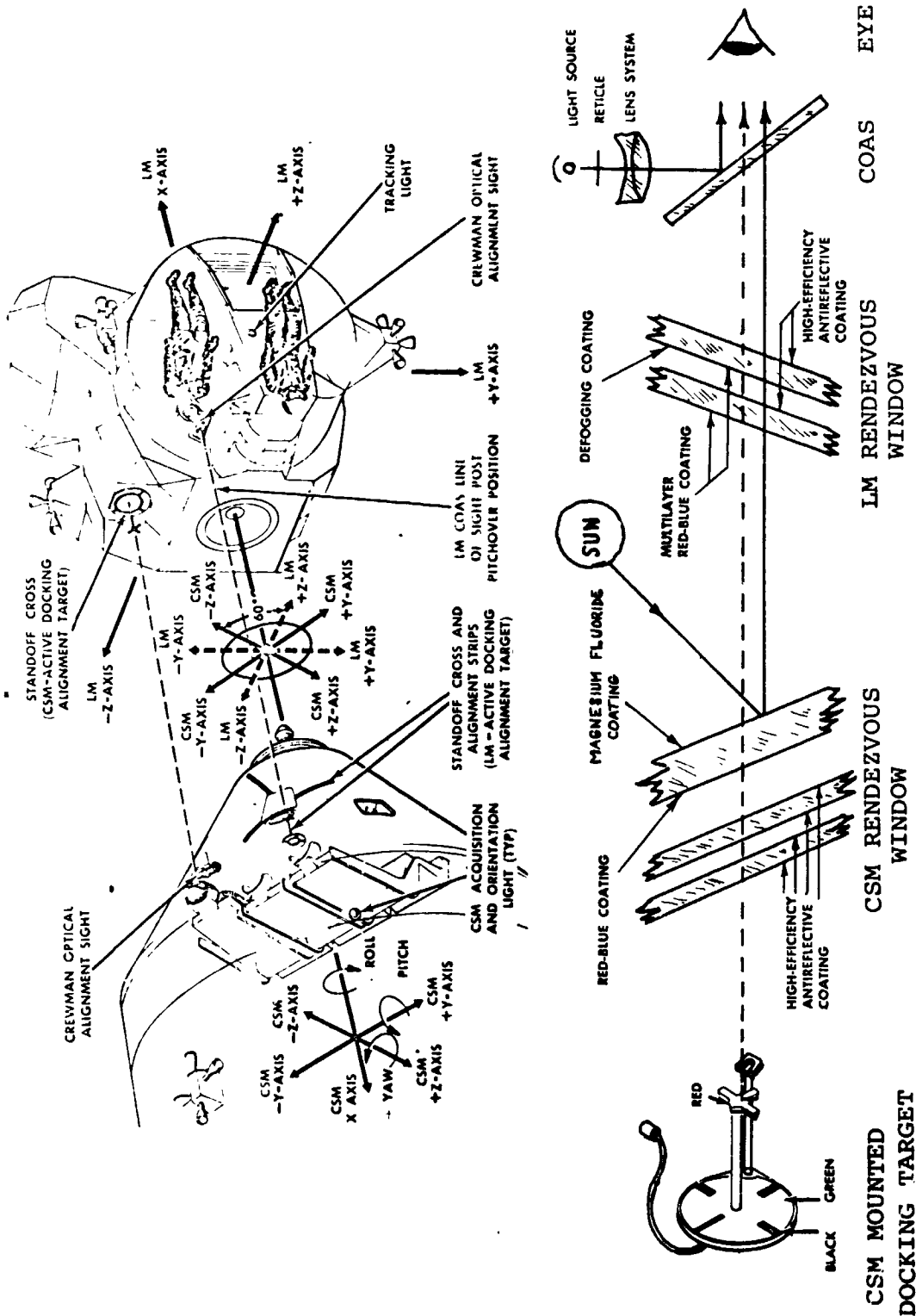


FIG. 2.1.35-3 OPTICAL PATH DETAILS

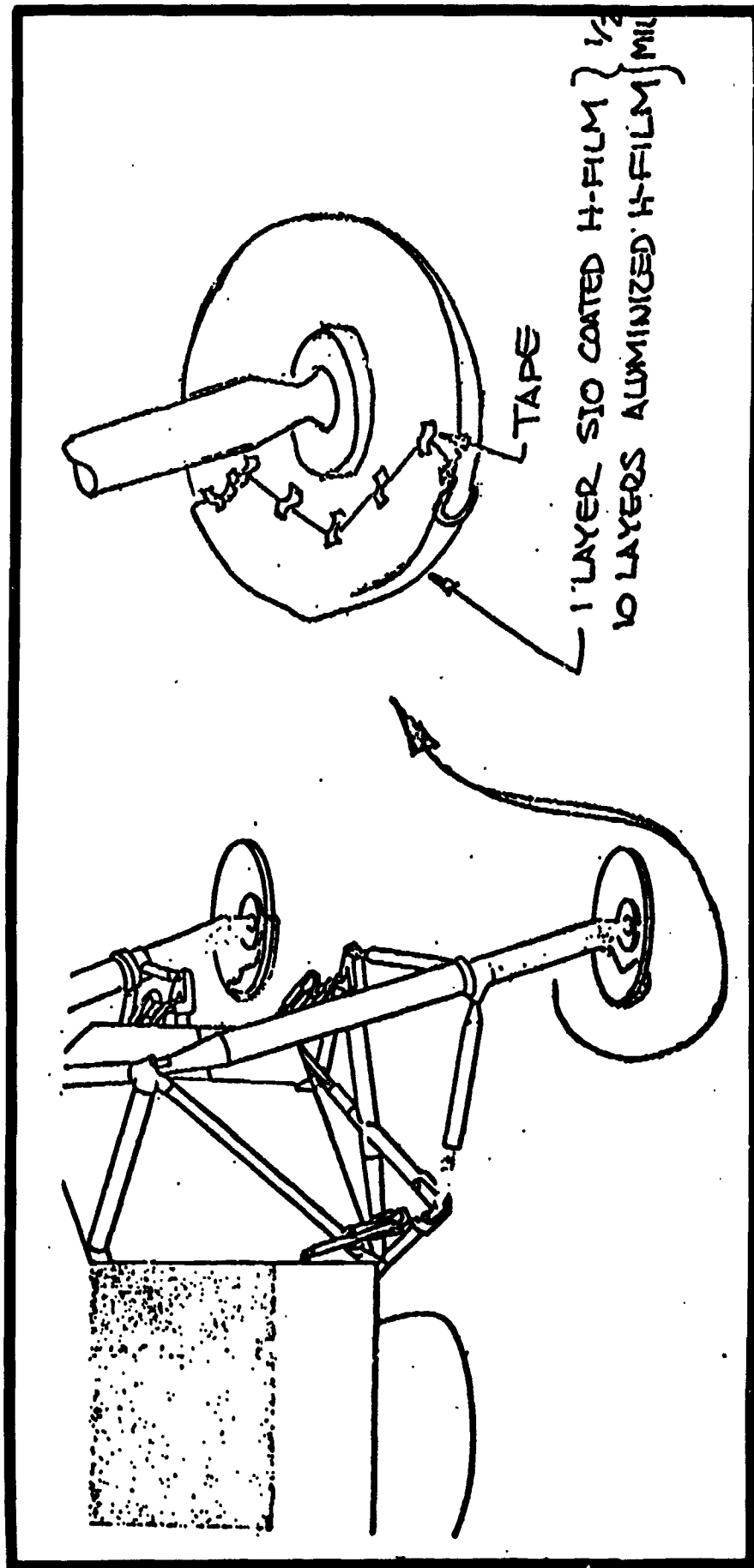
ANOMALY REPORT

NO. 2.1.36	TITLE: LOOSE PARTICLES DURING DPS BURN	MISSION: APOLLO 9
SYSTEM: LM		EVENT TIME: 49:37
SUBSYSTEM: STRUCTURE		
PROBLEM:	DURING THE FIRST DPS BURN, THE CREW (BOTH LM AND CSM) NOTED PIECES OF MATERIAL COMING FROM THE LM. PIECES WERE ROUGHLY TWO TO FIVE SQUARE INCHES IN AREA. THE CREW SUSPECTS THEY MIGHT BE PIECES OF MYLAR FROM LM. SOME PIECES WERE BLACK AND SOME WERE PART BLACK AND PART SILVER. THEY SUSPECT THERMAL SHIELD FLAKING.	
ACTION:	THE RADIANT HEAT IN THE ENGINE WILL BURN AWAY THE 5-MIL LAYER OF H-FILM TAPED TO THE EXTERIOR OF THE BASE HEAT SHIELD. CHARRED (BLACK) OR UNCHARRED (SILVER OR GOLD) H-FILM MAY BE OBSERVED DRIFTING FROM THE VICINITY OF THE LUNAR MODULE ON FUTURE MISSIONS DURING INITIAL DESCENT ENGINE FIRINGS.	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: APOLLO 9 MISSION REPORT MSC-PA-R-69-2 PG. 9-16 & 10-10		REV:
		85

DETAIL SHEET

ANOMALY 2.1.36

TITLE: LOOSE PARTICLES DURING DPS BURN



LANDING GEAR PROTECTIVE FILM

FIG. 2.1.36-1

ANOMALY REPORT

NO. 2.1.1.37	TITLE: DISCREPANT ASCENT TANK WATER QUANTITY INDICATION	
SYSTEM: LM	MISSION: APOLLO 9	
SUBSYSTEM: ECS	EVENT TIME: 125:00	
PROBLEM:	TELEMETRY DATA INDICATES ASCENT STAG. WATER USAGE RATE FROM TANK 1 WAS HIGHER THAN FROM TANK 2. AT 107 HR, TANK 1 INDICATED EMPTY AND TANK 2 SHOWED 25 PERCENT. USAGE RATE SHOULD HAVE BEEN EQUAL.	
ACTION:	NONE ANTICIPATED AS MSC DOES NOT LIST THIS ITEM AS A FLIGHT ANOMALY.	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC APOLLO 9 MISSION REPORT MSC-PA-R-69-2 PG. 9-22		REV:
		87

ANOMALY REPORT

NO. 2.1.1.38	TITLE: STRUCTURAL CONTACT AT S-IC SHUTDOWN	MISSION: APOLLO 9
SYSTEM: LM		EVENT TIME: 00:02:43
SUBSYSTEM: STRUCTURE (DPS)		
PROBLEM:	DATA INDICATE THAT THE LATERAL LOADS INTRODUCED AT S-IC SHUTDOWN CAUSED THE HELIUM DIFFUSER FLANGE ON THE DESCENT PROPELLANT TANK TO CONTACT THE SHEET METAL FLANGE OF THE UPPER DECK.	
ACTION:	ANALYSIS HAS SHOWN THAT THE CONTACT WOULD NOT DAMAGE EITHER THE UPPER DECK SHEET METAL FLANGE OR THE HEAVY DIFFUSER FLANGE OR TANK BOSS. ANALYSIS ALSO SHOWS THAT THE TANK AND PLUMBING ARE NOT OVER-STRESSED UNDER THIS CONDITION. THE LOWER WEIGHT OF LM-4, IN CONNECTION WITH THE S-IC EXPECTED SHUTDOWN CONDITION, WILL PRODUCE LESS DEFLECTION FOR APOLLO 10 THAN WAS EXPERIENCED ON APOLLO 9. FURTHER STUDIES ARE UNDERWAY FOR APOLLO 11 WEIGHTS AND SHUTDOWN TRANSIENTS.	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 30-DAY ANOMALY REPORT P-14		REV:
		88

DETAIL SHEET

ANOMALY 2.1.1.38

TITLE: STRUCTURAL CONTACT AT S-IC SHUTDOWN

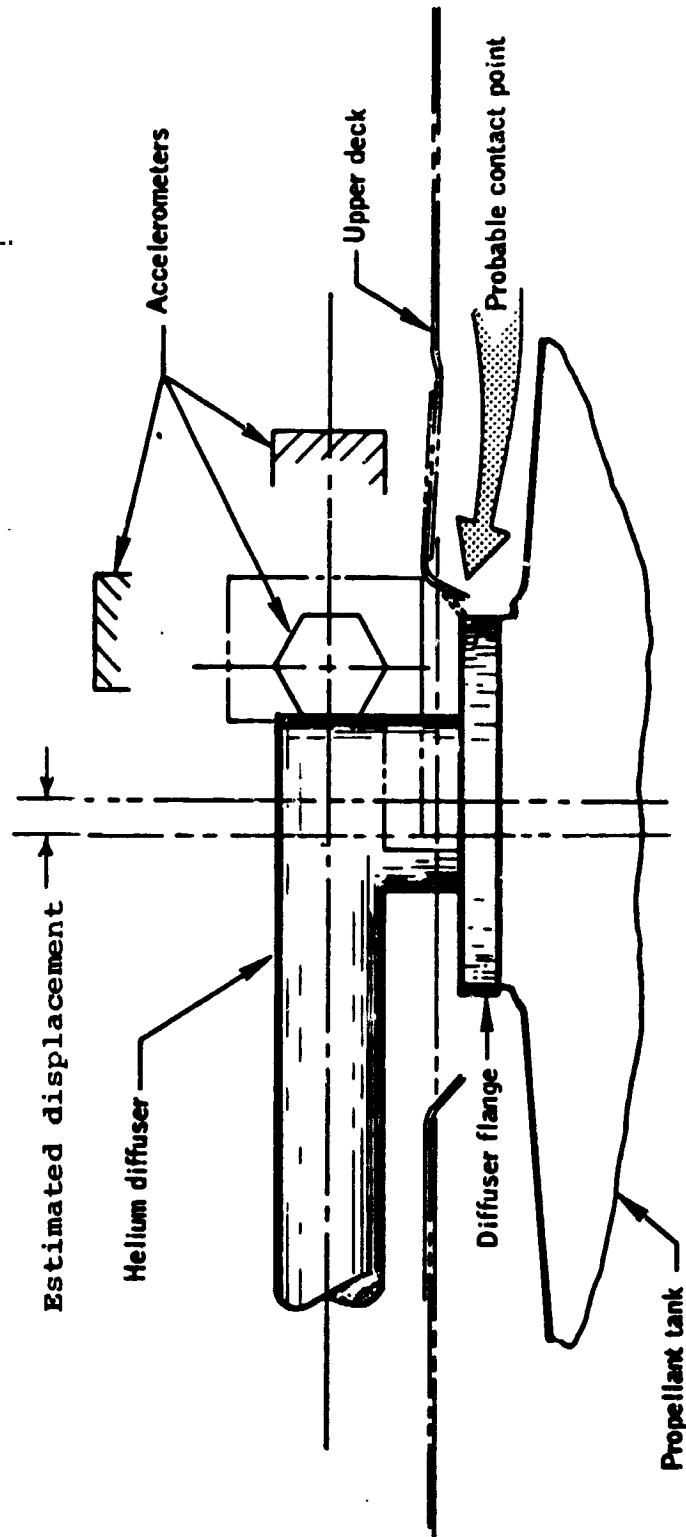


FIG. 2.1.38-1 PROBABLE TANK-TO-UPPER-DECK CONTACT POINT

ANOMALY REPORT

NO. 2.1.39	TITLE: BINDING OF FORWARD HATCH AND FAILURE OF DOOR STOP
SYSTEM: LM	MISSION: APOLLO 9
SUBSYSTEM: STRUCTURE	EVENT TIME: EVA
PROBLEM:	<p>THE CREW REPORTED THAT WHEN THE FORWARD HATCH WAS OPENED FOR EXTRA-VEHICULAR ACTIVITY, IT TENDED TO BIND ON TOP AND HAD TO BE PUSHED DOWNWARD TO OPEN IT. ALSO, THE DOOR WOULD NOT STAY OPEN.</p> <p>INSPECTION ON LM-5 SHOWED THAT THE VEHICLE FRONT FACE BLANKET ABOVE AND AROUND THE HATCH OPENING PROTRUDES BELOW THE VEHICLE FIXED STRUCTURE SHIELDING (IN AN AREA WHERE 0.250-INCH CLEARANCE SHOULD EXIST). THIS PROTRUSION IS IN THE PATH OF, AND INTERFERES WITH, THE HATCH SHIELD LIP. LM-4 WILL BE INSPECTED FOR SIMILAR CONDITIONS.</p> <p>THE DOOR STOP (SNUBBER) IS ATTACHED TO THE DOOR AND IS DESIGNED TO RIDE AGAINST A VELCRO PATCH ON THE FLOOR, THEREBY HOLDING THE DOOR OPEN. THE DOOR STOP DID NOT WORK IN FLIGHT.</p>
ACTION:	<p>CORRECTIVE ACTION FOR APOLLO 10 WILL BE TO EXTEND THE TOP HATCH SHIELD TO THE HATCH STRUCTURE, AND THE HATCH WILL BE TRIMMED TO INCREASE THE 0.08-INCH CLEARANCE TO 0.18 INCH.</p> <p>NO CHANGE WILL BE MADE ON THE FORWARD HATCH DOOR STOP FOR APOLLO 10 SINCE USE OF THE DOOR IS NOT PLANNED. THE SNUBBER IS BEING REDESIGNED FOR APOLLO 11 AND SUBSEQUENT.</p>
ORGANIZATION: 5-2490 REFERENCES: MSC-30 DAY ANOMALY REPORT P-13	RESOLUTION: CLOSED DATE: 6-13-69 REV:
	90

DETAIL SHEET

ANOMALY 2.1.39

TITLE: BIND OF FORWARD HATCH AND FAILURE OF DOOR STOP

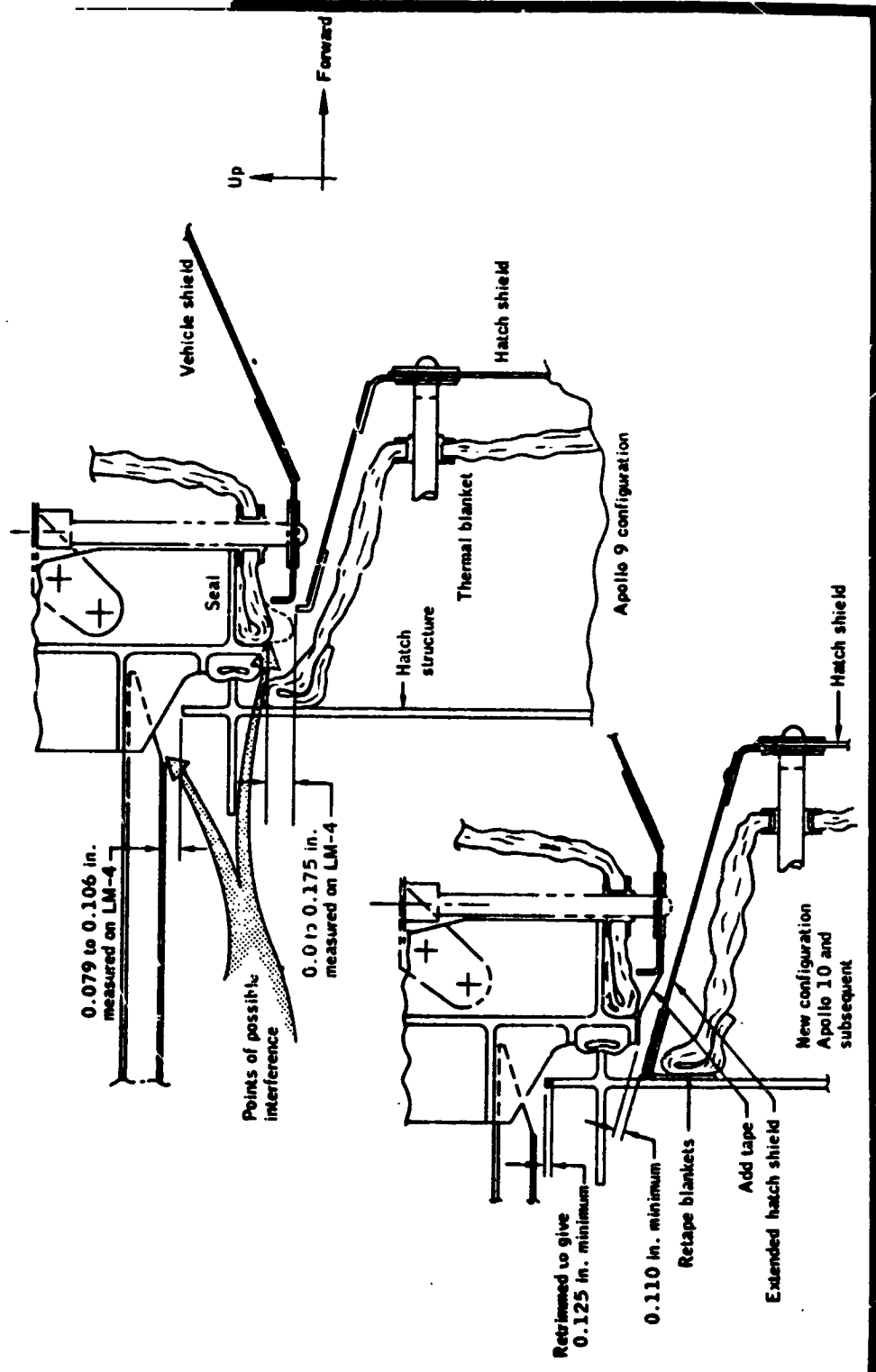


FIG. 2.1.39-1 POTENTIAL HATCH INTERFERENCE

DETAIL SHEET

ANOMALY 2.1.1.39

TITLE: BINDING OF FORWARD HATCH AND FAILURE OF DOOR STOP

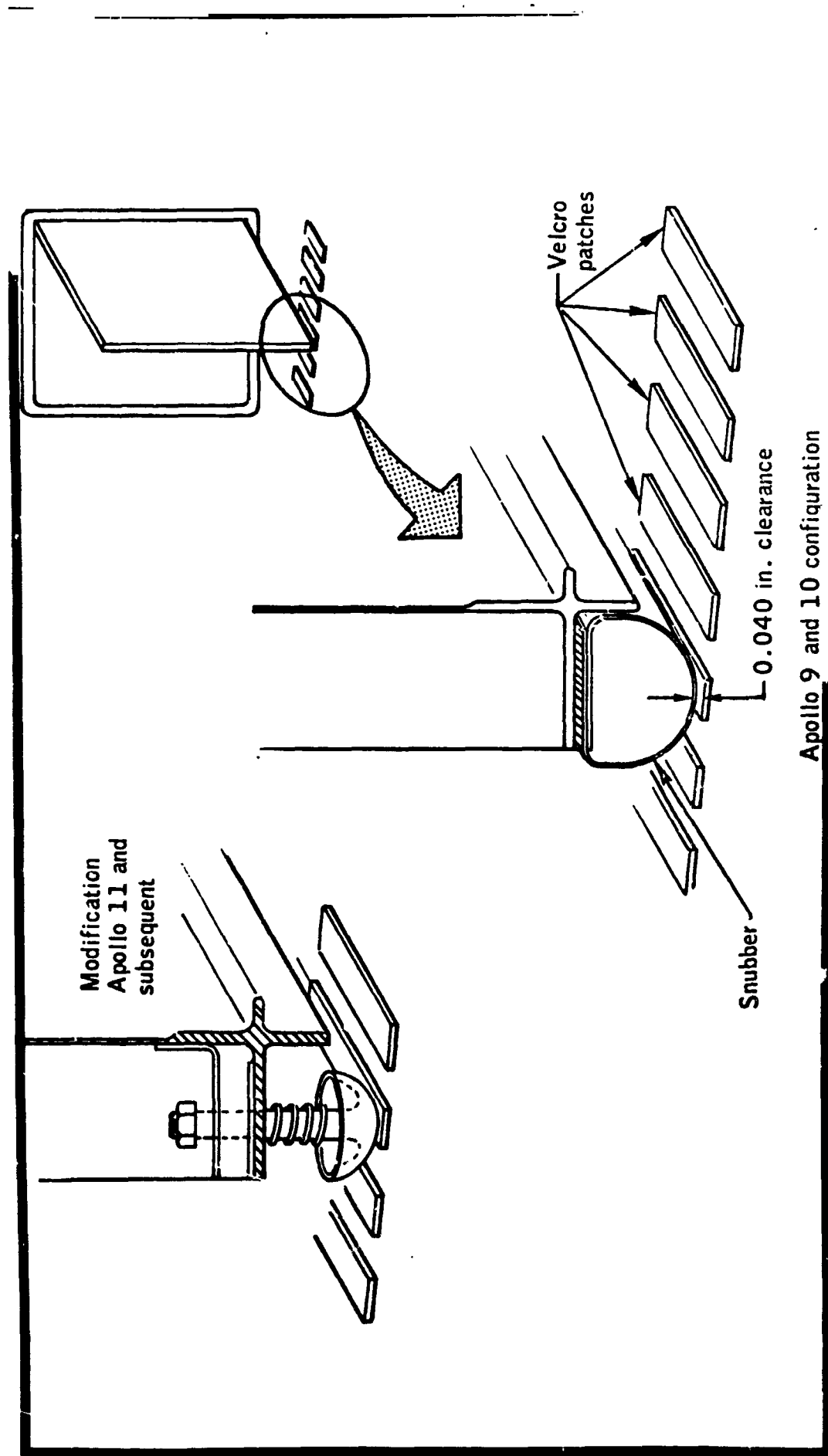


FIG. 2.1.39-2 FORWARD HATCH SNUBBER

ANOMALY REPORT

NO. 2.1.40	TITLE: DATA ENTRY AND DISPLAY ASSEMBLY OPERATOR ERROR LIGHT	
SYSTEM: LM	MISSION: APOLLO 9	
SUBSYSTEM: DATA DISPLAY	EVENT TIME: LM FLIGHT	
PROBLEM:	<p>THE CLEAR PUSHBUTTON ON THE DATA ENTRY AND DISPLAY ASSEMBLY WAS ROUTINELY ACTIVATED AT THE END OF EACH ENTRY OR DISPLAY OPERATION TO CLEAR THE ADDRESS AND DISPLAY REGISTERS. FREQUENTLY DURING THE MISSION, THIS PROCEDURE RESULTED IN ILLUMINATION OF THE OPERATOR ERROR LIGHT. THEREAFTER, FOUR OR FIVE DEPRESSIONS OF THE CLEAR PUSHBUTTON WERE OFTEN REQUIRED PRIOR TO ABORT SYSTEM OPERATIONS BEFORE THE OPERATOR ERROR LIGHT WOULD REMAIN EXTINGUISHED, ALTHOUGH IT WOULD GO OUT TEMPORARILY WHILE THE BUTTON WAS DEPRESSED.</p>	
ACTION:	<p>A REVIEW OF THE APOLLO 9 SYSTEM TEST HISTORY REVEALED TWO PREFLIGHT OCCURRENCES SIMILAR TO THOSE EXPERIENCED IN FLIGHT. ONE WAS AT THE VENDOR BEFORE ACCEPTANCE, THE OTHER DURING CHECKOUT AT THE LAUNCH SITE.</p> <p>APOLLO 10,11, AND 12 SYSTEM TEST HISTORIES HAVE BEEN RESEARCHED, AND NO EVIDENCE OF ANY OTHER PUSHBUTTON DISCREPANCIES HAS BEEN FOUND. ONE OCCURRENCE OF A FAILURE TO CLEAR WAS FOUND ON THE QUALIFICATION UNIT; HOWEVER, THE SUSPECTED CAUSE WAS FAILURE TO DEPRESS THE BUTTON COMPLETELY. THE CLEAR PUSHBUTTON AND ONE OTHER ON THE UNIT HAVE BEEN DISASSEMBLED WITHOUT FINDING CONTAMINATION OR ANY OTHER MECHANISM WHICH COULD HAVE CAUSED THE SYMPTOMS. IN ADDITION, TWO OF THE EIGHT PUSHBUTTONS WHICH WERE PART OF THE PUSHBUTTON QUALIFICATION PROGRAM HAVE BEEN DISASSEMBLED, AND NO DISCREPANCIES WERE FOUND.</p>	
ORGANIZATION: 5-2490	RESOLUTION: CLOSED	DATE: 6-13-69
REFERENCES: MSC 30-DAY ANOMALY REPORT, P-14		REV:
		93

DETAIL SHEET

ANOMALY 2.1.40

TITLE: DATA ENTRY AND DISPLAY ASSEMBLY OPERATOR ERROR LIGHT

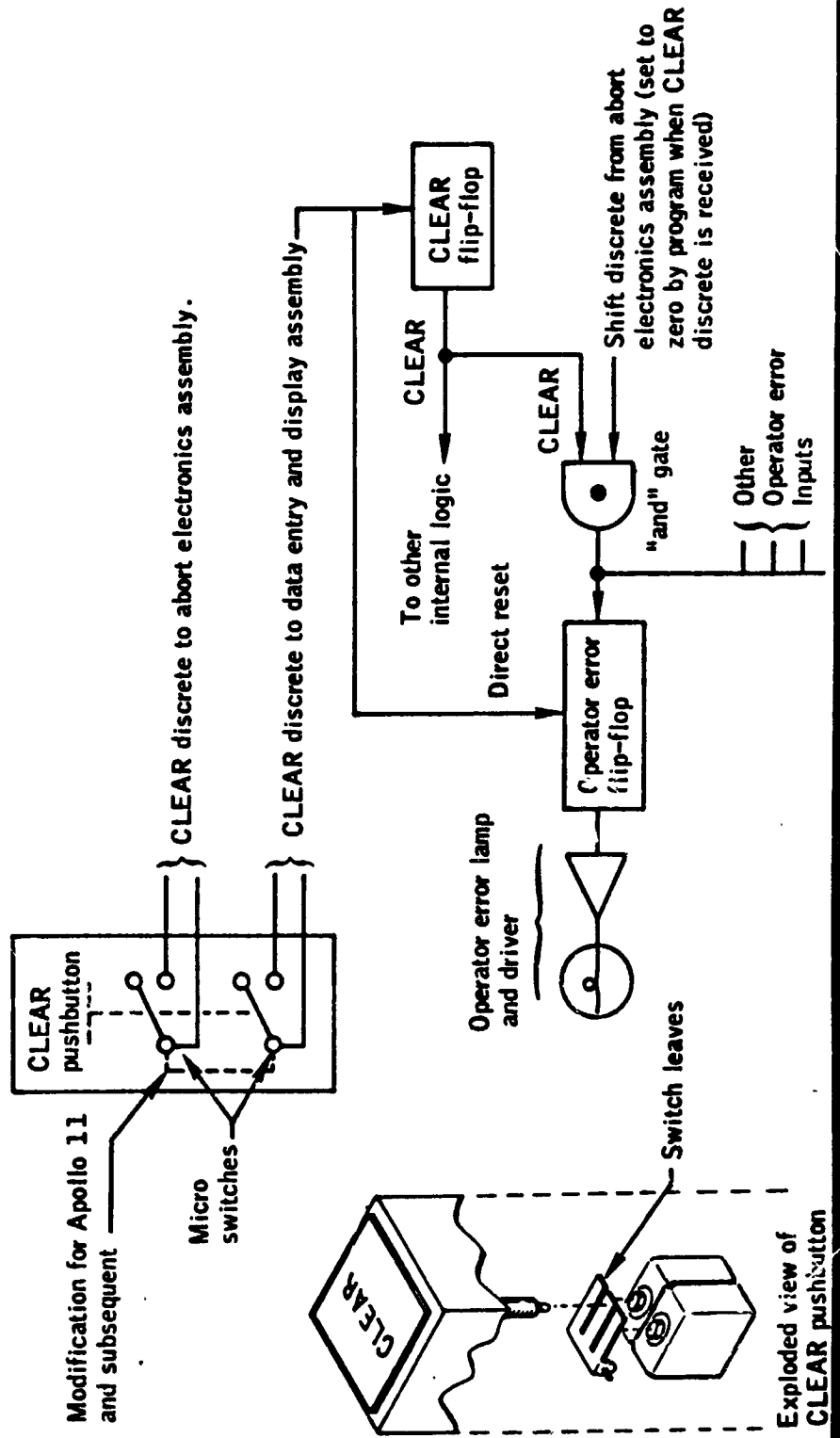


FIG. 2.1.40-1 Simplified data entry and display assembly operator error light circuit.

ANOMALY REPORT

NO. 2.2.1	TITLE: S-II PROPULSION/STRUCTURE OSCILLATIONS
SYSTEM: S-II	MISSION: APOLLO 9
SUBSYSTEM: PROPULSION & STRUCTURE	EVENT TIME: 0:08:20
PROBLEM: <p>LOW FREQUENCY PERFORMANCE OSCILLATIONS WERE EXPERIENCED BY THE CENTER ENGINE NEAR THE END OF S-II BURN. THESE OSCILLATIONS WERE SIMILAR TO, BUT APPEARED TO BE SOMEWHAT MORE SEVERE THAN THOSE OCCURRING ON THE AS-503.</p> <p>CENTER ENGINE THRUST CHAMBER PRESSURE OSCILLATIONS BEGAN AT APPROXIMATELY 500 SECONDS, PEAKED AT 506 SECONDS (PREDOMINANT FREQUENCY 16.9 HERTZ), AND DAMPED OUT AT 531 SECONDS. THE PEAK-TQ-PEAK AMPLITUDE OF CHAMBER PRESSURE OSCILLATIONS AT 506 SECONDS WAS ABOUT 55.2 N/CM² (80 PSI), AS COMPARED TO 41.4 TO 48.3 N/CM² (60 TO 70 PSI) MAXIMUM PEAK-TO-PEAK OSCILLATIONS OBSERVED IN THE CENTER ENGINE CHAMBER PRESSURE ON AS-503. DURING THE OSCILLATION PERIOD, SMALL AMPLITUDE OSCILLATIONS (16 TO 19 HERTZ) WERE ALSO EVIDENT IN THE OUTBOARD ENGINES CHAMBER PRESSURE MEASUREMENT.</p> <p>ACTION:</p> <p>CORRECTIVE ACTION PLANNED FOR AS-505 WILL BE TO CUT OFF THE CENTER ENGINE AT 299 SECONDS AFTER TIME BASE 3 (T₃) (NASA CHANGE ORDER 1643). THIS TIME IS APPROXIMATELY 40 SECONDS BEFORE THE OSCILLATION PROBLEM OCCURRED ON AS-504.</p>	
ORGANIZATION: REFERENCES:	RESOLUTION: CLOSED DATE: 5-16-69 REV:
	95

DETAIL SHEET

ANOMALY 2.2.1

TITLE: S-II PROPULSION/STRUCTURE OSCILLATIONS

DESCRIPTION:

OSCILLATIONS IN THE CENTER ENGINE THRUST CHAMBER BEGAN AT 499 SECONDS, PEAKED AT 506 SECONDS, AND DAMPED OUT AT 531 SECONDS. PEAK CENTER ENGINE CHAMBER PRESSURE OSCILLATIONS WERE 80 PSI PEAK-TO-PEAK AT 16.9 HERTZ; THE PEAK AMPLITUDE ON APOLLO 8 WAS 60 PSI PEAK-TO-PEAK. THE PEAK CROSSBEAM VIBRATION, MEASURED AT THE CENTER ENGINE PAD, WAS +12G. CROSSBEAM FREQUENCY AND CENTER ENGINE FREQUENCY WERE COINCIDENT FROM ABOUT 505 TO 522 SECONDS AND THESE FREQUENCIES VARIED FROM 16.5 HERTZ TO 18.8 HERTZ.

CENTER ENGINE LOX PUMP INLET PRESSURE REACHED A PEAK-TO-PEAK AMPLITUDE OF APPROXIMATELY 9.5 PSI AT 17.2 HERTZ AT 504 SECONDS. LOX PUMP DISCHARGE PRESSURE OF THIS ENGINE BEGAN OSCILLATING AT APPROXIMATELY 501 SECONDS, AND THE MAXIMUM PEAK-TO-PEAK AMPLITUDE OF 220 PSI AT 16.9 HERTZ OCCURRED AT 506 SECONDS. BOTH THE INLET AND DISCHARGE PRESSURE OSCILLATIONS DAMPED OUT AT 531 SECONDS. THE LOX PUMP AND CROSSBEAM ACCELEROMETERS REACHED PEAK ACCELERATIONS OF +8.0 AND +12.0 G RESPECTIVELY AT APPROXIMATELY 506 SECONDS: AND THE OSCILLATIONS OF BOTH DAMPED OUT BETWEEN 531 AND 532 SECONDS.

AT APPROXIMATELY 505 SECONDS, LOW AMPLITUDE OSCILLATIONS AT 17 HERTZ WERE OBSERVED IN THE LOX PUMP INLET, THRUST CHAMBER PRESSURES, AND THRUST PAD ACCELEROMETERS OF ENGINE NO. 1, WHICH WAS THE ONLY OUTBOARD ENGINE ON WHICH ADDITIONAL INSTRUMENTATION WAS INSTALLED.

ALL LONGITUDINAL ACCELEROMETERS IN THE AFT SKIRT RESPONDED AT FREQUENCIES FROM 9 TO 11 HERTZ, AS OPPOSED TO ALL ENGINE AND THRUST STRUCTURE MEASUREMENTS WHICH INDICATED 16.5 TO 20 HERTZ. THIS RESPONSE WAS SIMILAR TO AS-503.

THE LOX STEP PRESSURIZATION SEQUENCE, ADDED AS A CORRECTIVE PROCEDURE FOR APOLLO 9, WAS ACCOMPLISHED AS PLANNED AT 262.74 SECONDS. IT WAS SUCCESSFUL IN RAISING LOX TANK ULLAGE PRESSURE TO THE VENT VALVE CRACKING PRESSURE BAND OF 40 TO 42 PSIA PRIOR TO LOW ENGINE MIXTURE RATIO OPERATION, BUT THE INCREASED ULLAGE PRESSURE DID NOT ELIMINATE THE LONGITUDINAL OSCILLATIONS. IN ADDITION, ENGINE NO. 5 LOX INLET PRESSURE ROSE ABOUT 1 TO 2 PSI AND THEN DROPPED APPROXIMATELY 9 PSI AFTER INITIATION OF THE OSCILLATIONS.

DETAIL SHEET

ANOMALY 2.2.1

TITLE: S-II PROPULSION/STRUCTURE OSCILLATIONS

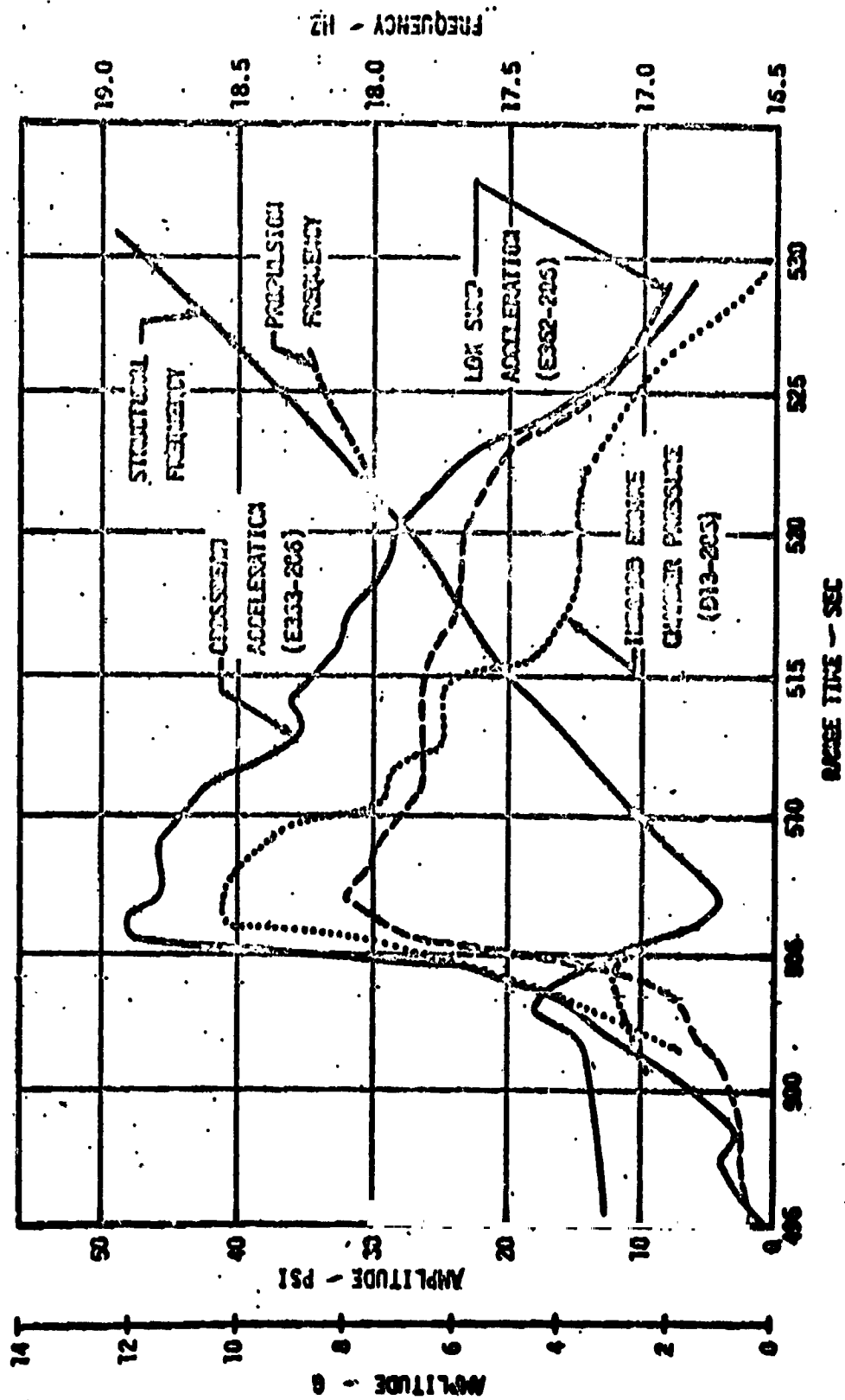


FIG. 2.2.1-1 AMPLITUDE AND FREQUENCY DURING S-II OSCILLATIONS

ANOMALY REPORT

NO. 2.2.2	TITLE: S-IVB APS MODULE NO. II HELIUM SUPPLY PRESSURE DECAY	
SYSTEM: S-IVB	MISSION: APOLO 9	
SUBSYSTEM: APS	EVENT TIME: 4:25	
PROBLEM:	<p>MODULE NO. 2 DEVELOPED A HELIUM LEAK AT APPROXIMATELY 4 HOURS 25 MINUTES. THE LEAK CEASED AT APPROXIMATELY 7 HOURS. THE AVERAGE LEAK RATE WAS 3851 SCCM (235 SCIM). THE PROBABLE CAUSE OF THIS PROBLEM WAS LEAKAGE OF ONE OR MORE TEFLON SEALS IN THE HELIUM HIGH PRESSURE SYSTEM UPSTREAM OF THE REGULATOR. THE MODULE NO. 1 REGULATOR OUTLET PRESSURE WAS MAINTAINED AT 137 N/CM² (199 PSIA). MODULE NO. 2 REGULATOR OUTLET PRESSURE WAS 131 TO 134 N/CM² (190 TO 195 PSIA) WHICH WAS BELOW THE 135+ 2 N/CM² (196 + 3 PSIA) REGULATION BAND.</p>	
ACTION:	<p>ECP 3160 HAS BEEN ISSUED, EFFECTIVE AS-505 AND ON. CORRECTIVE ACTION CONSISTS OF: (1) REPLACE THE TEFLON "O" RINGS UNDER 4 MC BULKHEAD FITTINGS WITH RUBBER "O" RINGS, (2) REINSPECT 5 FLARE TUBE FITTINGS FOR GALLING AND REPLACE DEFECTIVE POINTS SO FOUND, (3) PERFORM ONE HOUR 3000 PSI PRESSURE DECAY CHECK ON THE REWORKED SYSTEM, AND (4) RUN A 1500 PSI SOAP BUBBLE TEST ON THEIR REWORKED SYSTEM. AN ADDITIONAL LEAK CHECK HAS ALSO BEEN IMPLEMENTED AT KSC.</p>	
ORGANIZATION:	5-2490	
REFERENCES:	<p>MSFC 5-DAY REPORT, SECT. 4- P.3 MSFC 30-DAY REPORT, P.1 MSFC 60-DAY REPORT, P.7-61</p>	
	RESOLUTION: CLOSED	DATE: 5-16-69
		REV:
		98

DETAIL SHEET

ANOMALY 2.2.2

TITLE: S-IVB APS MODULE NO. II HELIUM SUPPLY PRESSURE DECAY

BACKGROUND: THE APS ENGINES ARE LOCATED IN TWO MODULES, 180 DEGREES APART ON THE AFT SKIRT OF THE S-IVB STAGE. THE MODULES ARE SELF-CONTAINED AND DETACHABLE. EACH MODULE CONTAINS FOUR ENGINES: THREE 150-POUND-THRUST CONTROL ENGINES AND ONE 70-POUND-THRUST ULLAGE ENGINE. EACH MODULE CONTAINS ITS OWN OXIDIZER, FUEL, AND PRESSURIZATION SYSTEMS. A POSITIVE EXPULSION, PROPELLANT FEED SUBSYSTEM IS USED TO ENSURE THAT HYPERGOLIC PROPELLANTS ARE SUPPLIED TO THE ENGINE UNDER ZERO OR RANDOM GRAVITY CONDITIONS. THIS SUBSYSTEM CONTAINS SEPARATE FUEL AND OXIDIZER PROPELLANT TANK ASSEMBLIES EACH CONTAINING A BLADDER FOR PROPELLANT EXPULSION.

ANOMALY REPORT

NO. 2.2. 3	TITLE: S-IVB STAGE PNEUMATIC REGULATOR READING HIGH	MISSION: APOLLO 9
SYSTEM: S-IVB	SUBSYSTEM: PNEUMATIC CONTROL	EVENT TIME: T-3:0 7:00
<p>PROBLEM: NO S-IVB STAGE REGULATOR PROBLEMS OCCURRED DURING CDDT. THE J-7 PNEUMATIC POWER CONTROL MODULE WAS CHANGED OUT AFTER CDDT BECAUSE OF SLUGGISH OPERATION OF SHUT-OFF VALVE D311. THE FIRST OPERATION OF THE NEW MODULE WAS DURING COUNTDOWN. THE OUTLET PRESSURE OF REGULATOR D305 INCREASED TO 619 PSIA DURING FINAL COUNTDOWN, EXCEEDING THE REDLINE VALUE OF 585 PSIA. AS A RESULT, PRESSURE WAS CONTROLLED BY THE BACKUP SYSTEM CONSISTING OF A PRESSURE SWITCH-ACTUATED SHUTOFF VALVE IN THE PNEUMATIC POWER CONTROL MODULE. THE REDLINE WAS RAISED TO 630 PSIA AND SEVERAL INTERLOCKS WERE JUMPERED FOR LAUNCH. EXCEPT THAT THE PRESSURE RAN BETWEEN 580 AND 610 PSIA MOST OF THE TIME, REGULATOR D305 FUNCTIONED ADEQUATELY UNTIL THIRD BURN RESTART PREPARATION. AT PREVALVE OPENING, THE REGULATOR OUTLET PRESSURE ROSE TO 615 PSIA, RESULTING IN ONE CYCLE OF THE BACKUP SYSTEM. THIS PRESSURE APPARENTLY DID NOT ADVERSELY AFFECT THE PNEUMATIC SYSTEM. THE MALFUNCTION IS BELIEVED TO BE CAUSED BY INTERNAL LEAKAGE IN THE REGULATOR DUE TO EITHER CONTAMINATION OR A MINOR DEFECT IN THE POPPET-TO-SEAT MATING.</p> <p>ACTION: MODIFICATIONS TO REGULATOR ON AS-505 AND SUBSEQUENT VEHICLES BY FCP 3158.</p>		
<p>ORGANIZATION: 5-2490</p> <p>REFERENCES: MSFC 5-DAY REPORT, SECT. 4, PP 2,3 MSFC 30-DAY REPORT, P. 1 MSFC 60-DAY REPORT, P. 7.15</p> <p>RESOLUTION: CLOSED</p> <p>DATE: 5-16-69</p> <p>REV:</p> <p>100</p>		

ANOMALY REPORT

NO. 2.2.4	TITLE: S-IVB THIRD BURN PERFORMANCE VARIATIONS
SYSTEM: S-IVB	MISSION: APOLLO 9
SUBSYSTEM: PROPULSION & CONTROLS	EVENT TIME:
PROBLEM:	<p>THE PURPOSE OF THE THIRD BURN WAS TO DEMONSTRATE RESTART CAPABILITY AFTER AN 80 MINUTE COAST AND DEMONSTRATE THE MISSION RULE RELATED TO A FAILURE OF BOTH CHILLDOWN SYSTEMS. OPERATION OF THE J-2 ENGINE DURING THIRD BURN WAS ANOMALOUS, AS A RESULT OF THE EXPERIMENTAL NATURE OF THE PREPLANNED "OUT-OF-SPECIFICATION" ENGINE RESTART.</p> <p>THREE VARIATIONS ARE:</p> <ol style="list-style-type: none">1. MAIN CHAMBER PRESSURE OSCILLATIONS WHICH PROBABLY RESULTED IN PARTIAL FAILURE OF ENGINE PNEUMATIC SYSTEM AND SUBSEQUENT LOSS OF ENGINE PERFORMANCE.2. GAS GENERATOR PRESSURE SPIKE AT START WHICH POSSIBLY DAMAGED GAS GENERATOR.3. ABNORMAL YAW AND PITCH CONTROL SYSTEM OSCILLATION DURING THIRD BURN. (OUT-OF-SPECIFICATION START CONDITIONS WHICH WERE EXPERIMENTAL). <p>AS A RESULT OF THE THIRD BURN ANOMALY, THE PLANNED PROPELLANT DUMP THROUGH THE ENGINE WAS NOT SUCCESSFUL.</p>
ACTION:	<p>THE FLIGHT MISSION RULES ALLOWING RESTART WITH RECIRCULATION SYSTEMS INOPERATIVE ARE BEING REVISED FOR APOLLO 10. AN EXPERIMENT DURING TIME BASE 8 (PROPELLANT DUMP) IS PLANNED TO OBTAIN ADDITIONAL VERIFICATION DATA OF NEW RULES. THE EXPERIMENT IS BY GROUND COMMAND AND DOES NOT REQUIRE HARDWARE OR SOFTWARE CHANGES.</p>
ORGANIZATION: 5-2490	RESOLUTION: CLOSED
REFERENCES: MSFC 5-DAY REPORT, SECT. 3, P.5 MSFC 30-DAY REPORT, P.2 MSFC 60-DAY REPORT, SECT. 7	DATE: 5-16-69 REV:
101	

DETAIL SHEET

ANOMALY 2.2.4

TITLE: S-IVB THIRD BURN PERFORMANCE VARIATIONS

DESCRIPTION:

THE PLANNED 53 SECOND FUEL LEAD FOR THIRD BURN START CONDITIONS WAS ACHIEVED, AND SATISFACTORY FUEL SYSTEM START BOX CONDITIONS WERE ATTAINED. HOWEVER, THE LOX START BOX CONDITIONS WERE ABOVE THE REQUIRED TEMPERATURE LIMITS, AS EXPECTED, DUE TO NO PLANNED LOX CHILLDOWN. A NORMAL START OCCURRED WITH SATISFACTORY ACHIEVEMENT OF MAINSTAGE.

THE FIRST INDICATION OF A PROBLEM WAS THAT THREE ENGINE ENVIRONMENT TEMPERATURE MEASUREMENTS BEGIN TO CLIMB OFF SCALE NEAR THIRD BURN START TANK DISCHARGE VALVE OPEN (STDV); HOWEVER, THE RELIABILITY OF THESE MEASUREMENTS IS QUESTIONABLE AT THIS TIME. PRELIMINARY RESULTS INDICATE THAT ENGINE THRUST WAS 4% LOWER THAN EXPECTED DURING THE INITIAL PERIOD OF THIRD BURN, AND ENGINE CHAMBER PRESSURE WAS ABOUT 20 PSI LESS THAN DURING SECOND BURN. (NORMAL CHAMBER PRESSURE IS ABOUT 750 PSI.)

THE LOX PUMP INLET PRESSURE DROPPED APPROXIMATELY 10 PSI AT STDV + 31 SECONDS. THIS DROP DID NOT AFFECT THE ENGINE CHAMBER PRESSURE, THEREFORE THE LOX PUMP INLET PRESSURE TRANSDUCER READING MAY BE IN ERROR. AT ABOUT THIS TIME THE MAIN LOX VALVE BEGAN A CLOSING TREND.

AT ABOUT +50 SECONDS, THE ENGINE HELIUM CONTROL REGULATOR PRESSURE DROPPED FROM 400 PSI TO APPROXIMATELY ZERO, ALTHOUGH THERE WAS ADEQUATE HELIUM SUPPLY BOTTLE PRESSURE TO THE REGULATOR THROUGHOUT THE BURN. ABOUT 10 SECONDS LATER, THE MAIN FUEL VALVE BEGAN A CLOSING TREND.

AT STDV + 91 SECONDS, THE LOX BLEED VALVE WHICH RECIRCULATES LOX BACK TO THE TANK OPENED, AND THE ENGINE CHAMBER PRESSURE DROPPED FROM 700 PSI TO 485 PSI. LOX FLOW DECREASED BY 600 GPM AND LH₂ FLOW DECREASED BY 3600 GPM. THE GAS GENERATOR VALVE ALSO STARTED A CLOSING TREND AT THIS TIME. ENGINE CHAMBER PRESSURE DROPPED SLOWLY UNTIL AT STDV + 141.7 SECONDS THE LH₂ BLEED VALVE OPENED, AND CHAMBER PRESSURE DROPPED FROM 435 PSI TO 385 PSI. THE GAS GENERATOR VALVE CONTINUED TO CLOSE SLOWLY DURING THE REMAINDER OF THE BURN. ENGINE CHAMBER PRESSURE DECLINED SLOWLY TO 330 PSI AT ENGINE CUTOFF. THE BURN WAS TERMINATED BY THE NORMAL PROGRAMMED CUTOFF FROM THE IU SWITCH SELECTOR AT STDV + 240 SECONDS AND THE CUTOFF TRANSIENT APPEARED NORMAL.

DETAIL SHEET

ANOMALY 2.2.4

TITLE: S-IVB THIRD BURN PERFORMANCE VARIATIONS

DESCRIPTION (CONT.)

FROM 25 SECONDS TO 100 SECONDS DURING THE S-IVB THIRD BURN, OSCILLATIONS WERE APPARENT IN THE ATTITUDE CONTROL SYSTEM. THE OSCILLATIONS WERE EVIDENT IN PITCH, YAW, AND ROLL AXES ATTITUDES, RATES, AND ENGINE DEFLECTIONS. THE RATES WERE LARGEST IN THE YAW AXIS, REACHING A MAXIMUM OF +4.7 DEGREES/SECOND AT 0.6 TO 0.7 HRS. THE OSCILLATIONS DAMPED OUT NEAR THE TIME OF THE PERFORMANCE SHIFT OF THE J-2 ENGINE. THE OSCILLATION COINCIDES WITH THE LOX SLOSH NATURAL FREQUENCY, AND MARGINAL LOX STABILITY WAS PREDICTED FOR S-IVB THIRD BURN WITHOUT THE SPACECRAFT. ALTHOUGH THE YAW ACTUATOR DID NOT EXCEED ITS TEMPERATURE SPECIFICATION, IT DID EXHIBIT UNEXPLAINED CYCLICAL TEMPERATURE VARIATIONS. DURING THE OSCILLATION PERIOD, THE YAW ACTUATOR PHASE LAG AND THE FLIGHT CONTROL SYSTEM YAW GAIN WERE SIGNIFICANTLY DIFFERENT THAN DURING GROUND TESTS. THE MALFUNCTION WAS APPARENTLY CAUSED BY ABNORMAL RESPONSE OF THE YAW SERVOACTUATOR TO THE STEERING SIGNALS FROM THE IU FLIGHT CONTROL COMPUTER. THE SYSTEM RESPONDED NORMALLY BOTH BEFORE AND AFTER THE OSCILLATION PERIOD. THIS IRREGULAR ACTUATOR RESPONSE WAS APPARENTLY CAUSED BY ADVERSE THERMAL AND VIBRATION ENVIRONMENTS.

AN ABNORMALLY HIGH COUNTERCLOCKWISE ROLL TORQUE WAS ALSO PRESENT, AND IT INCREASED AFTER THE PERFORMANCE SHIFT TO A MAXIMUM OF 244 LB-FT AT ABOUT 6:10 GET. IT THEN DECREASED TO 60 LB-FT AT 6:15 GET. THE ROLL TORQUE DURING THE FIRST S-IVB BURN WAS ONLY 5.8 LB-FT.

THE PLANNED DUMP OF PROPELLANTS THROUGH THE ENGINE NOZZLE DID NOT OCCUR. THE LAUNCH VEHICLE DIGITAL COMPUTER (LDVC) COMMANDED THE DUMP AND POWER WAS APPLIED TO THE SOLENOIDS, BUT THE OXIDIZER AND FUEL VALVES DID NOT OPEN. SUBSEQUENTLY, DUMP WAS ATTEMPTED BY GROUND COMMANDS PER THE MISSION RULES. WHEN THESE GROUND COMMANDS ALSO FAILED TO ACHIEVE LOX AND LH₂ DUMP, THE STAGE SAFING REQUIREMENTS WERE ACHIEVED BY VENTING THROUGH THE LOX AND LH₂ TANK NON-PROPULSIVE VENTS. LOSS OF THE PNEUMATIC CONTROL SUBSYSTEM PRESSURE PROBABLY CAUSED FAILURE OF THE ELECTRICALLY-CONTROLLED, PNEUMATICALLY-OPERATED MAIN PROPELLANT VALVES TO ACTUATE.

DETAIL SHEET

ANOMALY 2.2.4

TITLE: S-IVB THIRD BURN PERFORMANCE VARIATIONS

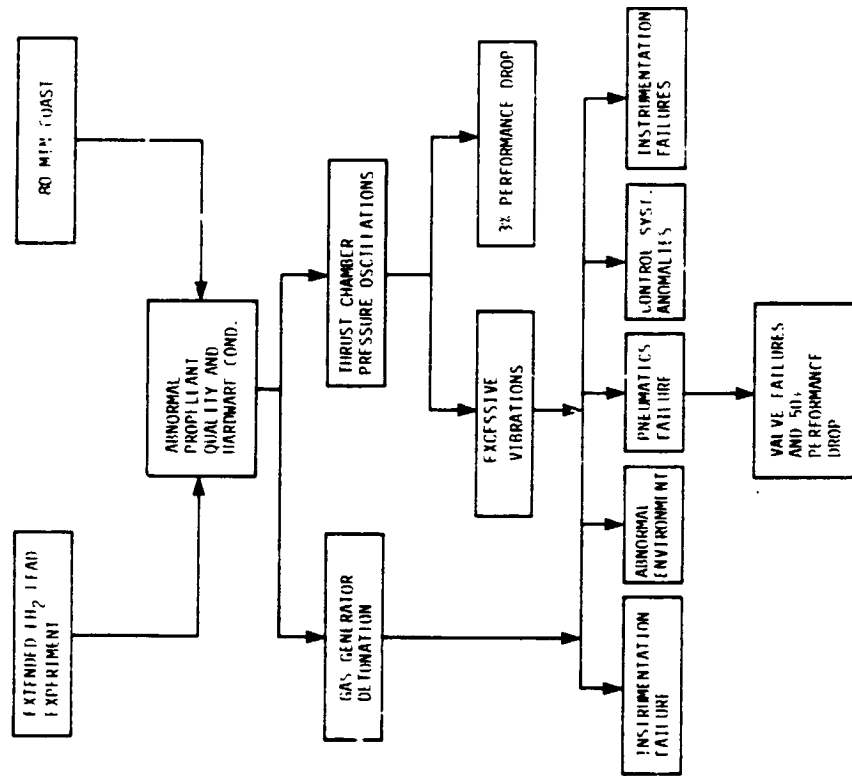


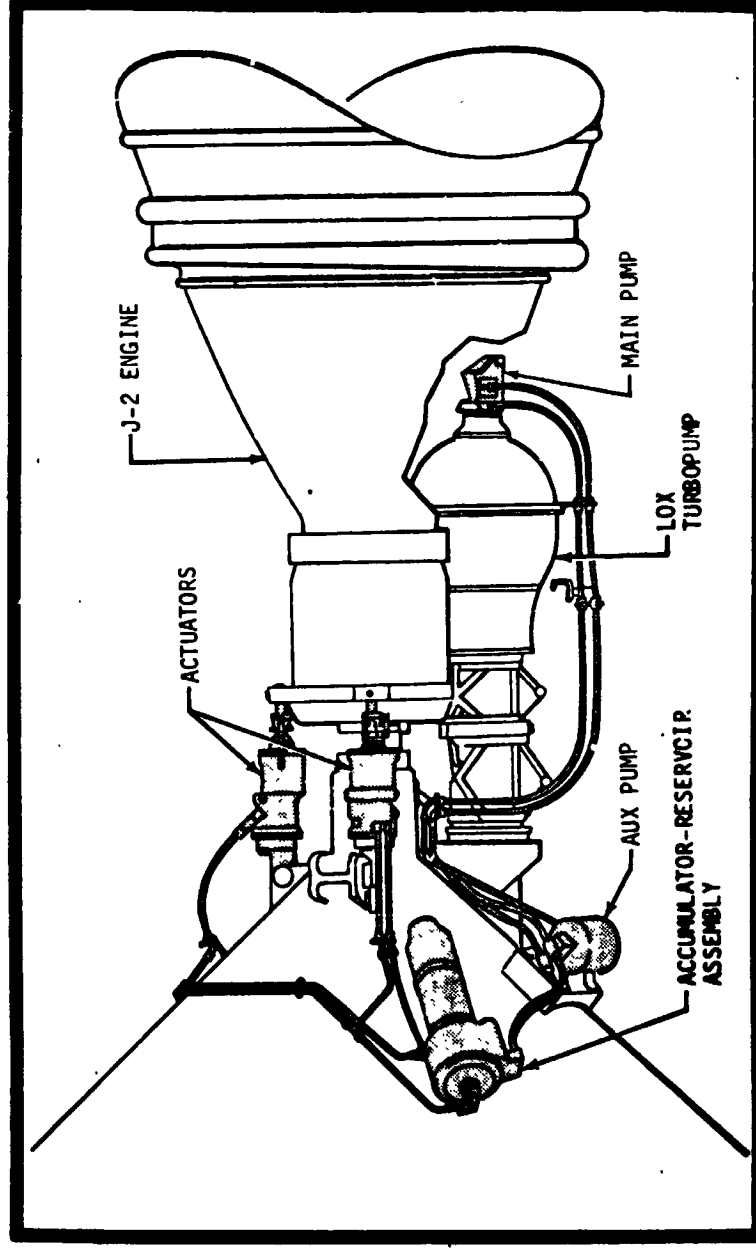
FIG. 2.2.4-1

FLOW DIAGRAM, SUMMARY OF S-IVB THIRD BURN ANOMALIES

DETAIL SHEET

ANOMALY 2.2.4

TITLE: S-IVB THIRD BURN PERFORMANCE VARIATIONS



S-IVB FLIGHT CONTROL SYSTEM HYDRAULIC COMPONENTS
FIG. 2.2.4-2

2.3.C

THERE WERE NO SIGNIFICANT GROUND SYSTEM FAILURES OR ANOMALIES ASSOCIATED WITH THE LAUNCH OF THE APOLLO 9 SPACE VEHICLE. THERE WERE SOME MINOR DISCREPANCIES AND THESE ARE LISTED BELOW.

- SERVICE ARM 1 LATCHBACK LATCH INDICATION FAILED.
- SERVICE ARM 4 HYDRAULIC WITHDRAWAL SYSTEM ACCUMULATOR LEVEL SWITCH RESPONSE.
- S-IVB PNEUMATIC POWER CONSOLE REGULATOR AND RELIEF VALVE FAILURES.
- S-IC LOX FILL AND DRAIN HEATERS RELAY FAILURE.
- DIGITAL DATA PROCESSOR (DDP-24) FAILURES.
- DOME REGULATOR RELIEF VALVE RELIEVED BELOW NORMAL LIMIT.
- FAILURE OF SERVICE ARM 6 "HYDRAULIC WITHDRAWAL HYDRAULIC SYSTEM CHARGING" INDICATION TO GO OFF.
- LINE PURGE REGULATOR LEAKAGE.

DETAILS OF THESE DISCREPANCIES MAY BE FOUND IN THE "APOLLO 9 GROUND SYSTEMS EVALUATION REPORT," MAY 7, 1969 (140-44-0012).

REFERENCES

1. APOLLO 9 MISSION 5-DAY REPORT, MSC-PT-R-69-11, MARCH 1969.
2. AS-504 5-DAY REPORT, MSFC, MARCH 19, 1969.
3. APOLLO 9 (AS-504) QUICK LOOK ASSESSMENT REPORT, K-098, MARCH 7, 1969.
4. APOLLO 9 30-DAY FAILURE AND ANOMALY LISTING REPORT, MSC-PT-R-69-13, APRIL 1969.
5. MSFC FAILURES AND ANOMALIES LIST, APOLLO/SATURN 504 MISSION, PM-SAT-T-69-69, APRIL 2, 1969.
6. APOLLO 9 MISSION FINAL DAILY REPORT, MARCH 13, 1969.
7. MISSION DIRECTOR'S SUMMARY REPORT, APOLLO 9, MARCH 13, 1969.
8. AS-504 FLIGHT ANOMALIES STATUS REPORT (TELECON), APRIL 7, 1969.
9. APOLLO 9 MISSION REPORT (60-DAY), MSC-PA-R-69-2, MAY 1969.
10. SATURN V LAUNCH VEHICLE FLIGHT EVALUATION REPORT AS-504 (60-DAY), APOLLO 9 MISSION MPR-SAT-FE-69-4, MAY 5, 1969.
11. APOLLO/SATURN V GROUND SYSTEMS EVALUATION REPORT APOLLO 9 (60-DAY) AS-504, 140-44-0012, MAY 7, 1969.